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7th Asian Fisheries Forum 04

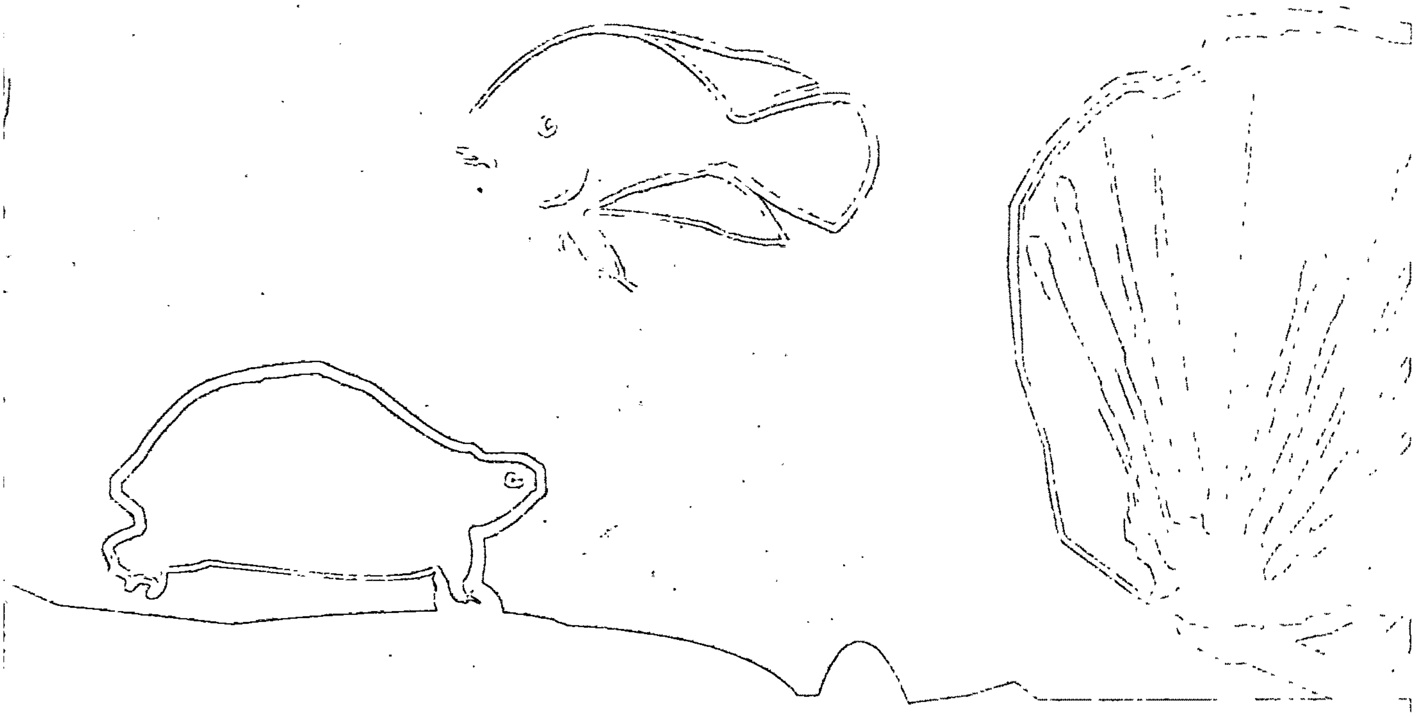
THE TRIENNIAL MEETING OF THE ASIAN FISHERIES SOCIETY

30 November - 4 December 2004 PENANG , MALAYSIA

ABSTRACTS

1

- ○ **Restoring and Sustaining Capture Fisheries**
- ○ **Socio-economic Perspectives**
- ○ **Understanding Aquatic Resources**
- ○ **Global Symposium on Gender and Fisheries**
- ○ **SS Fisheries Co-Management**
- ○ **SS Inland Fisheries**
- ○ **SS Managing Fishing Impacts on Sharks and Rays**
- ○ **SS Restocking and Stock Enchancement of Coastal Fisheries:** *Potential, Problems and Progress*



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Ministry of Agriculture and Agro - Based Industry Malaysia
Department of Fisheries Malaysia
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FOREWORD

The 7th Asian Fisheries Forum with the theme "New Dimensions and Challenges in Asian Fisheries in the 21st Century" comes at a time when the fisheries sector is facing challenges of declining production from capture fisheries and increasing demand for fish not only in Asia, but globally. Asian countries have been playing a pivotal role in global fish production and contributing to nutritional security of people especially in developing countries.

The Forum has attracted a large number of abstracts indicating the importance the scientists from the region and globally accord to the triennial forum of the Asian Fisheries Society. However, due to limited time during the Forum, it was not possible to accommodate all submissions for oral presentation. Many of the submissions were received very late much after the closing date for submission of abstracts. The Scientific Committee tried its best to include all the papers received in spite of their being received very late and managed to complete this Book of Abstracts on time due to the tireless efforts of many people in the Local Organizing Committee.

Unlike in the previous fora, 11 special symposia dealing with topics of importance covering both fisheries and aquaculture are being organized during the Forum. Presentations in these symposia are expected to address the constraints that deter the sustainable management and development of aquatic resources. There are plans to publish the proceedings of many of these special symposia in refereed journals.

On behalf of the Scientific Committee, I would like to thank all those who have given their time for reviewing/editing the abstracts received, chairing the various sessions and for convening the special symposia.

I wish all the participants productive four-day meetings.

MODADUGU V GUPTA
Chair, Science Committee

TABLE OF CONTENTS

Technical Sessions **1**

Restoring and Sustaining Capture Fisheries 1

Management Policies and Institutions 2

The long-term impact of coastal resources management in Panguil Bay, Philippines (Danilo C. Israel) 2

Management options for tropical shad *Tenualosa* fisheries in South and Southeast Asia (Stephen J.M. Blaber) 3

The tab: An emerging (sub-) regional fisheries organization for the Mekong? Why we need it, and what it should do? (Wattana Leelapatra*, Magnus Torell, Wolf Hartmann) 4

Impacts of irrigation on fisheries in rainfed rice farming landscapes (Kai Lorenzen, Sophie Nguyen-Khoa, Caroline Garaway) 5

People and policy change in Indian fisheries (S.D. Tripathi*, G. Haylor, W. Savage) 6

Developing a system of effectively managed marine sanctuaries in the Philippines: A national network strategy (Margarita Lavides*, Fernando Tiburcio, Jose Ma. Antonio Bringas, Isidore Ancog) 7

An ARIMA (0, 1, 1) model and bootstrap estimation for forecasting the annual total marine fish production in Malaysia (Mahendran Shitan*, Chin Hong Yee, R.P.P.K. Jayasinghe) 8

Potential access rights and governance of the coastal poor communities for harvest and culture of mollusks in Bangladesh coast (M.A. Salam*, A. Karmoker, T.A. Mukta, M.A.R. Hossain) 9

Identification of simple indicators of ecosystem health and exploitation status in the shrimp fishery in South Vietnam (Steen Christensen*, Dang van Thi, Douglas Clyde Wilson, Truong Hoang Minh) 10

Boom and bust fisheries in the Philippines: Monitoring a new seahorse fishery in Northern Bohol for management insights (H. Panes*, B. Giles, S. Morgan, D. Mccorry, A.C.J. Vincent) 11

Population dynamics and some aspects of biology of Hilsa *Tenualosa illisha* in Bangladesh and its management strategies (Rahman Md. Anisur*) 12

Status and management of fisheries in the sundarban mangroves of Bangladesh (Md. Emdadul Haque*, Mike Elliott) 13

Use of indigenous technical knowledge in Indian fisheries (A. Goswami*, B.K. Chand, P.K. Mukhopadhay, P. Biswas) 14

Fisheries management of bony fishes in the Iranian waters of the Caspian Sea (Shahram Abdolmalaki) 15

Community based fisheries management in the coastal area of Bangladesh: A case study (Runia Mowla*, Md.Ghulam Kibria) 16

Biology of *Gudusia chapra* in a community managed natural reservoir in Bangladesh and the impacts of the fish on the nutrition of the adjacent poor (Md. Mahfuzul Haque*, Md. Anisur Rahman) 17

Steps toward sustainable fisheries in the West and Central Pacific (Kenneth T. MacKay) 18

Stock Delineation 19

Estimating genetic differentiation and connectivity at nested spatial scales using microsatellite markers: Examples from two coral reef associated species with contrasting pelagic larvae duration and adult behavior (Ma. Carmen A. Ablan, Annadel Sarmiento Cabanban, Choulon Allen Chen, Amelia Goh Hui Xin)...... 19

Genetic variations of the shrimp *Penaeus chinensis* based on RFLP of mitochondrial control region (Zhaoxia Cui*, Ka Hou Chu, In Kwon Jang)......... 20

Effect of invasion of *Mnemiopsis leidyi* on pelagic fishery in the Caspian Sea (Farokh Parafkandeh Haghighi*) 21

Population structure and genetic linkages among *Caesio cuning* populations in Malaysia and adjacent regions (Amelia Goh Hui Xin*, Ma. Carmen Ablan, Shamala Palaniappan) 22

Stock Assessment 23

South and Southeast Asian seas: Linking resource and socio-economic assessment with management (Ilona Stobutzki*, Len Garces, Gerry Silvestre, Mahfuzuddin Ahmed) 23

Spatial patterns in the assemblage structure and temporal trends in species composition of demersal resources in South and Southeast Asia: A preliminary analysis (Len R. Garces*, Ilona Stobutzki, Geronimo Silvestre, Alias Man, Abu Talib Ahmad) 24

Historical changes in the fisheries resources of the East coast of Peninsular Malaysia (Nurulhuda Ahmad Fatan*, Ilona Stobutzki, Len R. Garces, Abu Talib Ahmad) 25

Tagging of *Litopenaeus vannamei* by tail-cutting (I Chiu Liao, Eduardo M. Leaño*) 26

Migration pattern and population dynamics of *Channa striata* in the rainfed rice farming landscape of Northeast Thailand (E. Amilhat*, K. Lorenzen) 27

Population dynamics *Penaeus semisulcatus* in Iranian waters of Persian Gulf (Shahram Ghassemi) 28

Fish catch assessment of floodplain fisheries in Bangladesh: A case study of Maljhee-kangsa floodplain (Nesar Ahmed*, Sushmita Rahman, Taposhi Mariam Begum, Shohidul Islam Akandha) 29

Culture-based fisheries in non-perennial reservoirs of Sri Lanka (W.M.H. Kelum Wijenayake*, U. Asanka D. Jayasinghe, J.A. Athula, K.B. Chandrani Pushpalatha, Upali S. Amarasinghe, Sena S. De Silva) 30

The effect of the commercial fishing closure on abundance of juvenile fish stocks at Towra Point, Botany Bay, NSW, Australia (Debashish Mazumder*, Neil Saintilan, Robert J. Williams) 31

Age and size compositions of Southern bluefin tuna *Thunnus maccoyii* caught by Taiwan longline fishery in the Indian Ocean (J.C. Shiao, Y.T. Lin, W.N. Tzeng*, S.K. Chang) 32

Directed fisheries for dolphins and dugong in Sabah, East Malaysia: Past and present (Saifullah A. Jaaman, Yuhana U. Lah-Anyi, Graham J. Pierce) 33

Taxonomy as a bottleneck in fisheries management: A case study from Cambodia (Eric Baran*, Chheng Phen) 34

Satellite based fishery forecasting for the benefit of coastal fisherfolk (V.N. Pillai*) 35

Population parameters of oyster *Crassostrea madrasensis* of Bangladesh coast (S.M. Nurul Amin*, M.A. Halim) 36

Multivariate approach: Status of small pelagics in the East coast of Malaysia (1976-98) (M. Shahab Uddin*, H.M. Ibrahim, M.A. Ambak, H. Yanagawa) 37

Habitat Restoration 38

Brush and vegetation park fishery in the floodplain River Titas; Brahmanbaria, Bangladesh (Md Sagir Ahmed) 38

Partnerships, collaboration and cooperation for effective marine resources management: The Fiji locally managed marine areas (FLMMA) network (Joeli Veitayaki*, Sakiusa Fong, Isoa Korovulavula, Semisi Meo) 39

Prawn landings and their relationship with the extent of mangroves and shallow waters in Western Peninsular Malaysia (N.R. Loneragan*, N. Ahmad Adnan, R.M. Connolly, F.J. Manson) 40

Side scan sonar images of artificial reefs (Dae Choul Kim, Gwang H. Lee, Young Kyo Seo) 41

Immediate impact of bottom trawling on macrobenthos with special reference to polychaetes in the inshore waters of Southwest coast of India (Joice V.Thomas, B. Madhusoodhana Kurup*) 42

Protected Areas 43

Impact of stocking on yield and biodiversity of non-stocked indigenous fish species in Oxbow Lakes with special reference to environment and livelihood (M.R. Hasan*, M.M.R. Talukder) 43

Seasonal abundance of benthic communities in coral areas of Pulau Karah, Terengganu, Malaysia (Wan Mohd Rauhan Wan Hussin*, Sakri Ibrahim, Zaleha Kassim, Sukree Hajisamae) 44

Understanding fish fights over fish rights: Conflicts and overcapacity in fisheries in Southeast Asia (Kuperan Viswanathan, Len Garces*, Nerissa Salayo, Mohammed Rab) 45

Effect of fish stocking size, density and fertilizer on water quality in rice fields for productivity enhancement in integrated rice-fish farming in hills of Nepal (Suresh Kumar Wagle, Tek Bahadur Gurung, Jay Dev Bista) 46

The angelwings (Family Pholadidae) of the Philippines: Status and prospects for development (Liberato V. Laureta) 47

Improvement of fishery resources in Chilika lagoon after opening of the new mouth (K.S. Bhatta*, A.K. Pattnaik, S. Mishra) 48

Some considerations on the population dynamics of *Thunnus albacares* in the Oman Sea (Farhad Kaymaram*, Bahram Kiabi) 49

Reducing By-Catch 50

Computerized fishing gear design and simulation tool (Chun-Woo Lee*, Ju-Hee Lee, Byeong-Guk Guk, Hyeong-Seok Kim, Gun-Ho Lee, Kwi-Yeon Koo) 50

Socio-economic Perspectives 51

Eco-labelling 52

Sustainability, ecolabelling and Asian fisheries (Frazer McGilvray) 52

Economic Policies and Institutions 53

Public and private sector institutional arrangements in fish genetic research and development: Issues and recommendations from Philippines case study (Belen O. Acosta* Ruben C. Sevilleja, Basilio M. Rodriguez Jr.) 53

User values of aquatic resources in the lower Mekong basin: Empirical evidences (Bee Hong Yeo*, Danilo C. Israel, Mahfuzuddin Ahmed, Meen Chee Hong, E. K Heng) 54

Economic loss from fish diseases on rural freshwater aquaculture of Bangladesh (Md. Ali Reza Faruk*) 55

Economic valuation, access analysis, and stakeholder-based planning for aquatic resources management in the lower Mekong Basin (Danilo C. Israel*, Mahfuzuddin Ahmed, Yeo Bee Hong) 56

Socioeconomic impact of aquaculture extension projects in improving livelihoods of fish farmers in Bangladesh (M. Serajul Islam*, M. Harun-Ar Rashid) 57

Towards sustaining marine and fisheries conservation: Economic valuation for conserving the Tubbataha Reefs, Philippines (Rodelio F. Subade) 58

An evaluation of the effectiveness of a child to child extension model for promoting effective pond aquaculture in rural Bangladesh (C.P. Morrice*, D. Brown, S. Islam) 59

Institutional Arrangement Analysis (IAA) of Indian shrimp farming – stake holders characteristics and their attributes on issues of sustainability in shrimp farming sector (D. Seenappa, C. Vasudevappa, Y.S. Arunkumar, Denis Bailly) 60

Research on technology dissemination: Worldfish center experiences in Bangladesh (Md Reazul Karim*, Naseem Aleem, Johannes Janssen) 61

Profiles of aquaculture demonstrations under Development of Sustainable Aquaculture Project (DSAP) in Bangladesh (Israt Zahura*, Murshed E-Jahan, Shameen Kamal, Manuara Azim) 62

Socio-economic characterization of inland fish farmers of Karnataka, India: A case study (Y. Basavaraju, Y.S. Arun Kumar*, Siddagangaiah, D.J. Penman, G.C. Mair) 63

Resource allocation efficiency of the carp-freshwater prawn *Macrobrachium rosenbergii* culture farmers of Bangladesh (Md. Ferdous Alam*, Khandokar M. Shameem Kamal, Khondker Murshed-E-Jahan, Md. Abul Kashem, Johannes Janssen 64

Impact of the supreme court judgement on shrimp farming in India (C. Vasudevappa*, Y.S. Arun Kumar, Y. Basavaraju, D. Seenappa, Denis Bailly). 65

WTO and Globalization 66

Impact analysis of fish trade liberalization on income and income distribution in the Philippines (Raymundo P. Addun) 66

Market and Marketing 67

An enquiry into the contribution of the fish marketing and distribution system to economic indicators in the Khulna City of Bangladesh (Khairul Azam*, Mohammad Nazmul Ahsan, Andrew Palfreman, Alan Marriot) 67

The sustainable livelihoods approach of freshwater prawn marketing systems in Bangladesh (Nesar Ahmed*, Taposhi Mariam Begum, Shohidul Islam Akandha, Sushmita Rahman) 68

Improving understanding of marketing interactions and their impact upon the poor: A case study of small scale aquaculture in northwest Bangladesh (Golam Faruque*, David C. Little, James A. Young, Madan M. Dey) 69

Quality of shrimp in the distribution channel: An approach in improving the livelihood of fisher community (K. Azam*, M.Z. Basher) 70

Shifting centre of gravity? Destination and product diversification in South Asian seafood exports (D.A.M. De Silva*, Masahiro Yamao) 71

Evaluating rural consumer preferences for inland fish and its substitutes in the dry-zone of Sri Lanka using participatory ranking and scoring techniques (F.J. Murray*, D.C. Little, Y. Naveratne) 72

Understanding Aquatic Resources 73

Fish and Invertebrate Biology 74

Taxonomic status of mud crab *Scylla* sp. in Bangladesh (Abu Tweb Abu Ahmed*, Mohammed Iqbal, Mohammad Mamun Chowdhury) 74

Self-fertilizing mangrove killifish *Rivulus marmoratus* as a model fish for marine aquaculture: Biology of two clonal strains (Maria Vivian Camacho Grageda*, Yoshitaka Sakakura, Masako Minamimoto, Atsushi Hagiwara) 75

Some aspects of the biology and conservation of *Horabagrus brachysoma* an endangered bagrid catfish from Vembanad Lake, India (G. Prasad*, Rajeev Raghavan, N. Sreeraj) 76

Preliminary biology study of Thai tunicate *Ecteinascidia thurstoni* for aquaculture (P. Koeysin, S. Chavanich*, K. Suwanborirux, V. Viyakarn, S. Piyatiratitivorakul, P. Menasveta) 77

The distribution of echinodermata at mussel culture area in Sebatu, Malacca (S. Ramli*, H. Omar, N.A. Aziz, A.R. Ismail, M. F. Osman, A.A. Wahab) 78

Seasonal changes in Perkinsus and Cercaria infections in the Manila clam *Ruditapes philippinarum* from Jeju, Korea (Thao T.T. Ngo*, Kwang-Sik Choi) . 79

Echinoderm associated with cultured mussel (S. Ramli*, H. Omar, N.A. Aziz, A.R. Ismail, B.A.G. Idris, M.F. Osman) 80

Occurrence of parasites, especially *Marteilioides chungmuensis* in Pacific oysters, *Crassostrea gigas* (Thao T.T. Ngo*, Kwang-Sik Choi) 81

Haematological response in ecophysiological adaptations in some fresh water fishes-concept of adaptational anaemia (B.N. Pandey*) 82

Growth and production of laboratory cultured cyclopoid copepod *Apocyclops dengizicus* (Lepeschkin, 1900) at different salinity levels (Omidvar Farhadian*, Fatimah M. Yusoff, Aziz Arshad, Perumal Kuppan) 83

Conservation of Biodiversity 84

Assessment of fish fauna in Beel Khukshia of Jessore, Bangladesh (J. K. Saha*, M.R. Hasan) 84

Study on paternal germplasm repository of selected indigenous freshwater fishes in Taiwan (Nai-Hsien Chao*, Shih-Ya Wang, Fu-Ning Tsai) 85

Study on pivotal temperature of green turtle *Chelonia mydas* on the east coast of Peninsular Malaysia (S. Abdullah*, I. Kamaruddin, I. Mazlan, T. Zulkifli) 86

Two species of horseshoe crabs, the *Carcinoscorpius rotundicauda* and *Tachypleus gigas* in Peninsular Malaysia (A. Christianus, C.K. Ng, P. Hajeb, C.R. Saad) 87

Migration and breeding of freshwater fishes in the beels of Eastern Bangladesh (K.K.U. Ahmed*, S.U. Ahmed, M.A. Mazid, K.R. Hasan) 88

Threatened fishes of rivers of Kerala (South India) with special reference to endemism, distribution and stock size (K.V. Radhakrishnan, B. Madhusoodana Kurup*) 89

Conserving Asian biodiversity: Impossible without information systems? (Boris Fabres*, Rodolfo Reyes Jr., Eli Agbayani, Josephine Rius) 90

Conservation of small indigenous species (sis) in flood-plain ecosystem, Bangladesh (Sadeka Halim*, Md. Kawser Ahmed, Md. Akhteruzzaman) 91

Estimated economic value of hail haor and estimation in a wetland in Malijhee floodplain for benefit of resource managers and community (Munir Ahmed*, Md. Shahadat Ali, Md. Akhtaruzzaman, Sachin Halder, Bill Collis) 92

Integrating fish farming with Makhana Eurale ferox (Janardan Jee*, Chandrawati Jee) 93

Effects and Mitigation of Pollution 94

Influence of industrial pollutants on thyroid and inter-renal functions in the fresh water, air-breathing teleosts *Channa punctatus* (Bloch): Environmental impact analysis (Tapati Bhattacharya*, Kamal Ray) 94

Biochemical response of the orange-spotted grouper *Epinephelus coioides* to suspended sediment (C.Y. Tse*, A.H. Pan, C.K. Wong, K.M. Chan) 95

Histopathological alterations as indicators for evaluating the sublethal effects of suspended sediment on the orange-spotted grouper *Epinephelus coioides* (A.P. Pak*, C.Y. Tse, O.N. Wong, K.M. Chan, C.K. Wong) 96

Critical Habitats: Mangroves, Aquatic plants, Mudflats, Corals, Seagrasses 97

Status of Malaysian coral reef fisheries (Annadel Salvio Cabanban*, Rooney Edward Biusing) 97

Macrobenthic communities of the Sita – Swarna estuarine complex, west coast of India (H.R.V. Reddy*, R.S. Nagendra Babu, R.J. Katti) 98

Blooming of phytoplankton in relation to nutrient flux in Hooghly estuary, North East coast of Bay of Bengal (T.K. De*, T.K. Jana) 99

Nutrient changes in a shallow tropical reservoir during wet and dry seasons (Jamaludin Jafri*, Fatimah Md. Yusoff, Aziz Arshad, Perumal Kuppan) 100

Preliminary studies on prawns at Nam Ou River, Luang Prabang province, Lao PDR (Latsamy Phounvisouk, Somboon) 101

Structure, composition and seasonal dynamics of the postlarval and juvenile shellfishes in the Sundarbans mangrove waters, Bangladesh (M. Enamul Hoq*, M. Nazrul Islam, M. Abdul Wahab) 102

Invasive / Introduced Species..103

Pattern of establishment of tilapia in reservoirs in Malaysia (A.G. Ponniah*, Norainy Mohd Husin , Zulkafli Abdul Rashid).. 103

The impact of introduced species on the genetic diversity of native freshwater fishes in Malaysia (Yuzine b. Esa*, Khairul Adha A. Rahim).......................... 104

Study on an introduced fish, *Helostoma temminckii* in Bakong River, Miri, Sarawak: Factors affecting its establishment & socio-economic impact (Kelvin Pudun Dennis, Khairul Adha A. Rahim, Yuzine Esa)..................................... 105

Exotic red-bellied *Piaractus brachypomus* in the Philippines: Potential impact to rice ecosystem (Arsenia G. Cagauan*, Ravindra C. Joshi)............................ 106

Special Symposium..**107**

Global Symposium on Gender and Fisheries 108

No shells, no Langalanga: Hard times in Malaita, Solomon Islands (Kristina Fidali-Hickie*, Cherie Whippey-Morris) 109

Sustainable aquaculture development: Impacts on social livelihood of ethnic minorities in northern Vietnam with emphasis on gender (Md.Ghulam Kibria*, Raymon Van Anrooy, Runia Mowla)... 110

Gender and coastal zone biodiversity (Krishna Srinath)................................ 111

Role of women and children in the management of mussel and oyster farms in the coastal areas of Cavite, Philippines (Jimmy T. Masagca)........................ 112

Subsistence, surplus and seaweed: Women's fishing and marine work in Kiribati (Jean Mitchell).. 113

An integrated approach on gender issues of fisheries project in coastal area of Bangladesh: Problems and challenges (Runia Mowla*, Md.Ghulam Kibria)... 114

Successive involvement of women: Closed water to open water fisheries (Anwara Begum Shelly*, Khan Muhammad Nurul Islam, Mohammed Alamgir) 115

"Confined mobility: the gendered impacts of aquaculture development in Northeastern Thailand" (Leah Sullivan) 116

Gender and generation: Crucial aspects of local fisheries management in Lelepa, Vanuatu (Jean Tarisesei, Irene Novaczek *)..................................... 117

Sex and nutritional status of under seven children in the coastal Barangays in Buenavista, Guimaras (Alice Joan G. Ferrer) 118

Nutritional status and socio economic empowerment of fisherwomen in coastal eco-system of Andhra Pradesh, Karnataka, Kerala & Tamilnadu (Vijaya Khader) 119

Integrating the gender perspective in nutrition and occupational health in fisheries sector (Arpita Sharma*, R.S. Biradar, S.C. Mukherjee).................... 120

A study on women's involvement in processing and globalization in fisheries and aquaculture in Taiwan (Nai-Hsien Chao*, Meng-Hsien Chen, Yu-Huei Chen) 121

Women in fish border trade: Case of fish trade between Cambodia and Thailand (Kyoko Kusakabe*, Prak Sereyvath, Ubolratana Suntornratana, Napaporn Sriputinibondh)... 122

Underutilised medicinal marine plants as resources for rural women's development in the South Pacific (Irene Novaczek) 123

The involvement of female labour in seafood processing in Sri Lanka: Impact of organizational fairness and supervisor evaluation on employee commitment (D.A.M. De Silva*, Masahiro Yamao) 124

Alternative livelihood options for female workers in shrimp processing industries of Bangladesh (Md. Nazmul Ahsan*, Asma Haque Airin, Mosammat Rowshan Ara) 125

Women's participation in traditional fish processing: Experience of Proshika under CBFM in village Daspara, Kuliarchar in Bangladesh (Md. Abdur Rahman *, Sabuj Kumar Chowdhury) 126

Selling fish in Tarawa, Kiribati (Maere Tekanene) 127

Gender stratification in fish production systems: Women do have economic power (Marieta Banez-Sumagaysay*) 128

Gender status in Indian fisheries education, research and development organizations (M.C. Nandeesha) 129

Gender mainstreaming in Mekong fisheries: From policy to practice (Napaporn Sriputinibondh*, Kaing Khim, Nguyen Thi Bich, Kanokporn Deeburee, Nouhak) 130

A study of women fishers empowerment in different level of co-management processes (CMPS) (a case study in fishing community in Pemalang and Demak regencies, Central Java - Indonesia) (Indah Susilowati) 131

Responding gender and development issues in coastal areas: Lessons learned from Pangangan Island, Calape, Bohol, Philippines (Joselito Francis A. Alcaria*, Chona M. Tura) 132

Looking for women in Philippine Fisheries Policies: Research to determine advocacy points for fisheries (Jovelyn T. Cleofe) 133

European fisherwomen contribution in fisheries and its legal recognition (Katia Frangoudes) 134

Women participation in fisheries activities in Manipur valley in India with traditional fish based beliefs and customs (S.D.Gurumayum, M.C.Nandeesha*) 135

Women and fisheries in Bangladesh: Level of involvement and scope for enhancement (Md. Kawser Ahmed *, Sadeka Halim) 136

Valuing local knowledge in the Canadian Arctic: How the involvement of local peoples results in relevant resource management decisions (Joanna Kafarowski *) 137

Fisheries Co-Management 138

Women's role in community based fisheries management Project-2 (Ms. Nargis Akter) 139

Different approaches of community based fisheries management: Proshika experience in Bangladesh (Sabuj Kumar Chowdhury) 140

Community enterprise on fisheries for sustainable and equitable development in flood-plain area- a poverty reduction strategy (Sakiul Millat Morshed*, Nurul Haque Sujon) 141

An analysis of co-management arrangements: Case of a fishing district in Fiji Islands (Patrick Sakiusa Fong*, Joeli Veitayaki, Bill Aalbersberg) 142

Fishing for the future: Co-management and the introduction of rights-based fisheries management systems (Theo Ebbers*, Sammy Malvas) 143

Missing the fish for the trees? Fisheries co-management and community forestry in Southeast Asia – Lessons to be learned (Wolf Hartmann*, Vitoon Viriyasakultorn) 144

Fisheries co-management in Lao PDR – the user perspective (Sommano Phounsavath*, Nam Suang, Huei Siet, Pak Beung, Wolf D. Hartmann) 145

Alternative sources of income: A way out in fisheries management? (kaing khim*, wolf d. Hartmann) 146

Tragedy of the resources ownership in marine protected area: Case study in West-Lombok, Indonesia (Arif Satria*, Yoshiaki Matsuda, Masaaki Sano) 147

Current decentralization of fisheries management in Indonesia (Arif Satria*, Yoshiaki Matsuda) 148

Money matters: Credit and savings as important elements of fisheries management (Nguyen Thi Bich*, Wolf D. Hartmann) 149

Marketing as an essential function in fisheries co- management: The cases of Huay Luang (Thailand) and Nam Houm (Lao PDR) (Sommano Phounsavath*, Kanokporn Deeburee, Wolf D. Hartmann) 150

Media - A powerful tool to create awareness in the community for fisheries resource development or, an agent in creating mass awareness in community based fisheries management project (Ms. Nargis Akter) 151

Coastal area management by local organizations: How people participate in their community development, case study approach in Thailand (Wantana Chenkitkosol*, Masahiro Yamao) 152

Communication planning for participatory management of fisheries conflicts in Cambodia and India (Kuperan Viswanathan, Christopher Garforth, Nerissa Salayo*) 153

Community based organization: Key for sustaining CBFM approach (Anwara Begum Shelly*, Md. Alamgir, K.M. Nurul Islam, Thomas Costa) 154

Community managed fish sanctuaries: Experience gained from CBFM-2 project in Bangladesh (Mohammod Ilyas*, Mohammod Sharoar Jahan Tareq, M. Anisul Islam) 155

The influence of social actors on community development: The case of a fishing community in southeastern Philippines (Ladylyn Lim Mangada*) 156

Livelihood analysis of the shrimp processing workers in Bangladesh (Md. Akteruzzaman) 157

Participatory monitoring of trends in yield – data collection and sharing of what for what? (Sompanh Chanpengxay*, Malasri Khumsri, Chhoun Kimchhea, Kanokporn Deeburee, Trung Ha Phuong, Wolf D. Hartmann) 158

Economics of fisheries co-management: How much does it cost, and how to pay for it? (Trung Ha Phuong*, Sommano Phounsavath, Wolf D. Hartmann) 159

Community-based monitoring of a seahorse fishery using fisher log books (B.G. Giles, D. McCorry*, A.M. Torrechilla, J.A. Erediano, A.C.J. Vincent) 160

Community perceptions of marine protected areas in Northern Bohol, Central Philippines: Management, benefits and threats (D. McCorry*, J.A. Erediano, B. Giles, A.P. Blanco) 161

The effect of co-management processes on enforcement and compliance with fisheries regulation (Ida M. Siason) 162

Impact of CBFM microfinance program on the livelihoods of fishers and fisheries production in Bangladesh (Md. Ferdous Alam*, K. Kuperan Viswanathan) 163

Management of fish sanctuary: Legal issues and options (Shakil Ahmed Khan) 164

Fisheries management and legal aspect of CBFM (M. Iqbal Kabir) 165

Analysis of key livelihood constraints of primary stakeholder groups by using SI approach as a tool: Experiences of CBFM-2 project in Bangladesh (Mohammod Sharoar Jahan Tareq*, Mohammod Ilyas, M. Anisul Islam) 166

PAPD (Participatory Action Plan Development) - A participatory tool for consensus building among stakeholders of multi functional wetlands: Experiences of CBFM-2 project in Bangladesh (A. M. Islam*, M.M. Rahman, S. K. Chowhan) 167

Co-management approach in project implementation: Experiences of CNRS (an NGO) in implementing four selected co-management projects in Bangladesh (Mohammod Sharoar Jahan Tareq*, M. Anisul Islam, M. Mokhlesur Rahman) 168

Pollution issues and its treatments in CBFM-2 project (Md. Anwaruzzaman). 169

Community fisheries management in Cambodia - Challenges and options for sustainable management (Paul W. Namisi) 170

Inland Fisheries 171

Cambodian freshwater fisheries: An overview (Eric Baran*) 172

Catch monitoring for fisheries assessment in the Songkhram river, upper northeast Thailand (Ubolratana Suntornratana*, Anupong Sanitchon, Kent G. Hortle) 173

Marketing infrastructure, distribution channels and trade pattern of inland fisheries resources in Cambodia: An exploratory study (Mohammed A. Rab*, Hap Navy, Seng Leang, Keang Seng, Mahfuzuddin Ahmed) 174

Reservoir fisheries of Sri Lanka: Present status and future strategies for management (Upali S. Amarasinghe) 175

Spatial and temporal variations in fish assemblages of an arid zone floodplain river, Cooper Creek, Australia: Implications for environmental flows (Angela Arthington*, Steve Balcombe) 176

Socioeconomics and values of aquatic resources in Cambodia: Results from a sample survey of Great Lake Tonle Sap and Mekong Bassac Rivers (Mohammed A. Rab*, Hap Navy, Mahfuzuddin Ahmed) 177

Lessons learnt from a one year trial of opening the sluice gates on a dam of the Mun River (a tributary of the Mekong) in Thailand - The fisheries viewpoint (Tuantong Jutagate*, Chaiwut Grudphan, Thanatip Lamkom) 178

Fish migrations in the Mun river, a Mekong tributary in Thailand, with special reference to *Morulius chrysophekadion* and *Helicophagus waandersi* (Tuantong Jutagate*, Pratak Tabthipwon, Sena S. De Silva) 179

Benthic fauna in the Mun River and its tributaries during the opening of the sluice gates of the Pakmun Dam (Kanjana Payooha,* Praneet Ngamsnae, Chaiwut Grudphan, Thanatip Lamkom) 180

Maadevalayal – Unique fishing method in Valapatanam river (M.P. Remesan, A. Ramachandran*) 181

Estimating consumption of fish and other aquatic animals in the Mekong Basin: A comparison of interview and measurement methods (Joseph G. Garrison*, Kent G. Hortle, Douangkham Singhanouvong, Lam Thanh Pham, Wirawan Rayan, Sokanyn Mao) 182

Status of Katha (Fish aggregating device) fishery in the river Titas of Brahmanbaria, Bangladesh (M.G. Mustafa*, Mahbubur Rahman Khan, K. Kuperan Viswanathan) 183

Managing Fishing Impacts on Sharks and Rays 184

The challenges facing management and conservation of Chondricthyans in Asia (Ilona Stobutzki*, Stephen Blaber) 185

The records of elasmobranch species from Malaysia (Ahmad bin Ali*, Yano, Kazunari, Albert, Chuan Gambang, Sollahuddin, A. Razak, Aznan Zainal).... 186

A progress report on collaborative research into the sustainability of Australia's Northern sharks and rays (John Salini*, Richard Pillans) 187

Studies on the dogfish shark fishery in the Northwestern coastal region of Sri Lanka (D.C.T. Dissanayake*, R.A.M. Jayathilaka, C. Amarasiri) 188

Some aspects of shark and ray artisanal fisheries in South of Indonesia (Dharmadi*, Fahmi, W.T. White, J. Widodo) 189

Size composition and fishery status of some common sharks in Indonesian waters (Fahmi*, Kurnaen Sumadhiharga) 190

Elasmobranch resources of Sabah, Malaysia (B. Mabel Manjaji*, Rooney Biusing, Annadel Cabanban) 191

Artisanal elasmobranch fisheries in South-eastern Indonesia: The target longline fishery for sharks in Lombok (William T. White*, Dharmadi, Fahmi) 192

Socio-economic aspects of shark and ray fishing in Indonesia (Malcolm Tull, Simon Vieira) 193

Toward a regional policy for the management of shark fisheries in Southeast Asia (Olivier Delahaye Gamucci*, Trian Yunanda) 194

National plan of action for sharks in Indonesia (Johannes Widodo, Rachel D. Cavanagh*) 195

Shark catches in Malaysia (Abd.Haris Hilmi Ahmad Arshad*, Ahmad Ali, Albert Chuan Gambang, Ahemad Sade, Lim Chai Fong) 196

Assessing the sustainability of elasmobranchs in Indonesian artisanal fisheries using risk assessment techniques (Richard Pillans*, Margaret Miller) 197

Recent records of *Glyphis* and *Lamiopsis* from Northern Australia and South-east Asia (H.K. Larson, P.R. Last, R.D. Pillans, J.D. Stevens*, D.C. Thorburn) 198

Sawfish (*Fa. pristidae*) catch data in Northern Australian waters: A desktop study (Jenny Giles) 199

Restocking and Stock Enhancement of Coastal Fisheries: Potential, Problems and Progress 200

Lessons learned from 30 years of restocking and stock enhancement of marine invertebrates (Johann D. Bell*, Peter C. Rothlisberg, John L. Munro, Neil R. Loneragan) 201

The importance of identifying spatial population structure in restocking and enhancement programs (Robert D. Ward) 202

A metapopulation in a large pelagic fish? Stock structure in Northern Australian narrow-barred Spanish mackerel, indicated by genetics, otolith isotope ratios and parasites (R. C. Buckworth*, S. J. Newman, J. R. Ovenden, R. J. Lester, G. R. Mcpherson) 203

Population dynamics of fisheries stock enhancement (Kai Lorenzen) 204

Merits of restocking and other forms of management for restoring severely over-exploited fisheries for Trochus *Trochus niloticus* and sandfish *Holothuria scabra* (Warwick J. Nash) 205

No-Take-Zones for restocking of the sea cucumber *Holothuria scabra* defined through modelling of movement dynamics (Steve Purcell) 206

Fish health management in marine stocking programmes (Devin M. Bartley*, Rohana Subasinghe) 207

Successful stock enhancement of the Japanese scallop *Patinopecten yessoensis* in Hokkaido (Nagashisa Uki) 208

Lessons learned from Japanese marine finfish stock enhancement programs (Shuichi Kitada) 209

Achievements and lessons learned in restocking giant clams (Edgardo D. Gomez*, Suzanne Mingoa-Licuanan) 210

The causes and consequences of enhancement outcomes: Socio-economic lessons learned from inland fisheries in Southeast Asia (Caroline Garaway). 211

Recreational anglers' willingness to pay for increased catch rates of Pacific threadfin *Polydactylus sexfilis* in Hawaii (Caroline Garaway) 212

Stock enhancement in Taiwan (I Chiu Liao, Eduardo M. Leaño*) 213

Stock enhancement programs of Kuruma prawn *Marsupenaeus japonicus* in Japan: Stocking effectiveness and release strategy (Katsuyuki Hamasaki) ... 214

Stock enhancement and transplantation of marine shrimp *Fenneropenaeus chinensis* in China (Wang Qing-Yin*, Zhuang Zhi-Meng, Deng Jing-Yao) 215

New directions for research in prawn enhancement: Experience from Exmouth Gulf, Australia (Neil R Loneragan*, Yimin Ye, Rob A. Kenyon, Mick D. E. Haywood) 216

Potential for enhancing spiny lobster production in Australia through the capture of *Puerulus* larvae for ongrowing and release (Caleb Gardner*, Stewart Frusher, David Mills, Megan Oliver) 217

Contribution of stocked mud crab *Scylla paramamosain* to commercial catch estimated by genetic stock identification (Yasuhiro Obata) 218

Stock enhancement and aquaculture of *Anadara granosa* (blood cockles) in relation to other coastal activities in Penang, Malaysia (Ian Bryceson*, Mohd Zambri Mohd Akhir, Mohd Noor bin Noordin) 219

Poster 220

Short term effects of bottom trawling on Foraminefera and Harpacticoida along the coastal waters of Kerala (S.India) (Sreedevi C., B. Madhusoodana Kurup*) 221

Ethnometeorological knowledge (EMK) and fishing practices in Parongpong island, Catanduanes, Philippines (Minerva I. Morales*, Asuncion V. Asetre). 222

Characterization of small-scale fishing communities for coastal zone management plan in 10th. Region (South of Chile) (Luis Francisco Oliva* and Masahiro Yamao) 223

Discards of bottom trawling along Kerala coast in India and its impact on marine biodiversity (B.Madhusoodana Kurup) 224

Observations on the distribution and biology of *Chlorophthalmus bicornis* (Family Chlorophthalmidae) beyond 250m depth along the South-west coast of Indian Eez. (B. Madhusoodana Kurup*, Jiji Thomas, S. Venu) 225

Effects of fish gathering from octagonal dome artificial reefs in Tongyeong marine ranching area, Korea (Jung-Goo Myoung, Jeong-Ho Park, Sun-Hyung Cho, Yong-Joo Park, Rae-Sun Kang, Kyung-Pyo Hong and Jong-Man Kim). 226

Seasonal abundance of reef fishes in relation to live coral coverage in Pulau Karah, Terengganu, Malaysia (Wan Mohd Rauhan Wan Hussin*, Sakri Ibrahim, Zaleha Kassim, Sukree Hajisamae) 227

Fish distribution in relation to breeding grounds in coastal waters of Terengganu, South China Sea (Zuliatini Mohd Joni*, Sakri Ibrahim, Zaleha Kassim, Sukree Hajisamae) 228

Composition of food items of fish in coastal waters of Terengganu, South China Sea (Zuliatini Mohd Joni*, Sakri Ibrahim, Zaleha Kassim, Sukree Hajisamae)229

Heavy metal concentrations in water, sediment and shrimp from grow-out farms in Johore, Malaysia (Saberi Mawi*, Mohd. Ismail Mohd. Said) 230

Temporal partitioning by *Hampala macrolepidota* in the lotic habitat of Kenyir reservoir (Ahmed Jalal Khan Chowdhury*, Mohd Azmi Ambak, F.M. Yusoff, Sakri Ibrahim, Mohd. Zahangir Alam) 231

Status of fisheries resource and management approach in three open beels in Bangladesh (M.G. Mustafa) 232

Fish community of two rural lakes and socio-economic assessment in Bumbung Lima, Kepala Batas(Azma-Hanim Ismail*, Mashhor Mansor, W.O. Wan Maznah) 233

Determination of stock/unit population of Indian mackerel *Rastrilliger kanagurta* through morphological characteristic in the South China Sea of Malaysian water (S.Abdullah*, B. Yosni, M.I.Mansor, I. kamariah) 234

Population biology of the marbled octopus *Octopus dollfusi* Robson, 1928 caught by trawl fisheries in Prachuap Khiri Khan province (J. Thitiwate*, C. Nitithamyong, T. Boonwanich) 235

Impact of fishing practices on the exploitation of floodplain fisheries resources in Brahmanbaria, Bangladesh (Md Sagir Ahmed*) 236

Relation of habitat parameters with abundance of four critically endangered and endemic fishes-development of habitat suitability index models (T.G. Manojkumar, B. Madhusoodana Kurup*) 237

On the sustainability of deep sea prawn fishery off Kerala (South India) (Radhika Rajasree, B. Madhusoodana Kurup*) 238

An overview of fisheries education and research in Bangladesh universities (Md. Sagir. Ahmed) 239

Spatial pattern in household fish demand: The case in the Philippines and Bangladesh (Ferdinand J. Paraguas*, Madan Mohan Dey, Anton Abdulbasah Kamil, Yolanda Garcia) 240

Socio-economics of prawn culture development in Bangladesh for sustainable livelihoods of the rural poor (Nesar Ahmed*, Sushmita Rahman, Taposhi Mariam Begum) 241

Distribution of endemic and threatened aquatic plant species in the Polonnaruwa district of Sri Lanka (A.S.L.E.Corea) 242

Fish diversity and inter-site relationship of headwater streams of Terengganu, Peninsular Malaysia (Norhayati Ibrahim, Rohani Mahmud, Amirrudin Ahmad*) 243

Freshwater fish diversity and their socio-economic potential at Batang Kerang, Balai Ringin, Sarawak, Malaysia (Khairul Adha A. Rahim, Kelvin Pudun Dennis, Yuzine Esa) 244

Status of fish genetic resources of the rivers of Kerala (S. India) and an evaluation of the fish germplasm for their suitability for aquaculture and ornamental purposes (B.Madhusoodana Kurup*) 245

Habitat utilization for juvenile and young snappers (Lutjanidae: Pisces) in the Matang mangrove estuary, West coast of Peninsular Malaysia (Katsuhiro Kiso) 246

Image analysis of typhoon impacts on soft coral community at Southern Jeju, Korea (Do-Hyung Kang*, Jun-Im Song, Kwang-Sik Choi) 247

Effect of tannery effluent on the nonspecific immune responses in tilapia *Oreochromis mossambicus* (M.Prabakaran, Dieter Steinhagen, R.Dinakaran Michael*) 248

Effect of diazinon on different life stages of rotifer *Brachionus plicatilis* (Helen S. Marcial*, Atsushi Hagiwara) 249

Distribution and chemical composition of tar balls along Terengganu beach, Malaysia (Law Ah Theem*, Yong Jaw Chuen, Johnson Koh Ching Chern).... 250

Bioaccumulation and depuration of pyrene in oyster *Crassostrea iredalei* (Chin Kam Yew*, Law Ah Theem) 251

Changes in haemolymph nitrate and protein concentrations in different sizes and genders of black tiger prawn *Penaeus monodon* (Chansawang Ngamphongsai*, Sorawit Powtongsook, Roger Uglow, Piamsak Menasveta) 252

Purification and partial characterization of serum immunoglobulin in Caspian Kutum *Rutilus frisii kutum* (M. R. Kalbassi *, M. A. Pouya, A. Mostafaii) 253

Some aspects of the biology of *Pseudapocrypte lanceolatus* distributed in the coastal areas of the Mekong delta, Vietnam (T.D. Dinh.*, M.A. Ambak, H. Anuar, N.T. Phuong) 254

Freshwater fishes of Balai Ringin, Sarawak (Khairul Adha A. Rahim, Kelvin Pudun Dennis, Yuzine Esa) 255

Ecological studies on the sand dollar, *Astriclypeus manni* (Verril 1867)-feeding, density and locomotion (Do-Hyung Kang, Byung-Gul Lee, Choi, Young-Chan, Kwang-Sik Choi*) 256

Shell colour polymorphism in Trochacean gastropod *Umbonium vestiarium* (l.) from Teluk Aling, Penang, Malaysia (Aileen Tan Shau-Hwai*, Zulfigar Yasin, Rushaliza Abdul Halim) 257

The survival rate of pearl oyster *Pinctada maxima* using two transportation methods (Cheah Wee*, Aileen Tan Shau-Hwai, Zulfigar Yasin) 258

Haematological study of green turtle *Chelonia mydas* in captivity in Terengganu, Malaysia (Najiah Musa*, Marina Hassan, Kamaruddin Ibrahim, Nazuki Sulong, Mohd Norhalim Kandar) 259

Population genetic structure of *Oreochromis niloticus* from Balung river, Sabah, Malaysia using sequencing analysis of cytochrome c oxidase I (CO1) mitochondrial DNA fragment (Yuzine B. Esa*, Sulinda binti Hassan) 260

A trial of tagging to study migration of fish in the Mekong River System, Cambodia (Zeb Hogan, Samy Em*, Phanara Tach, Kent G. Hortle) 261

Fishery resources assemblage and management in the river Titas of Brahmanbaria, Bangladesh (Mustafa Golam) 262

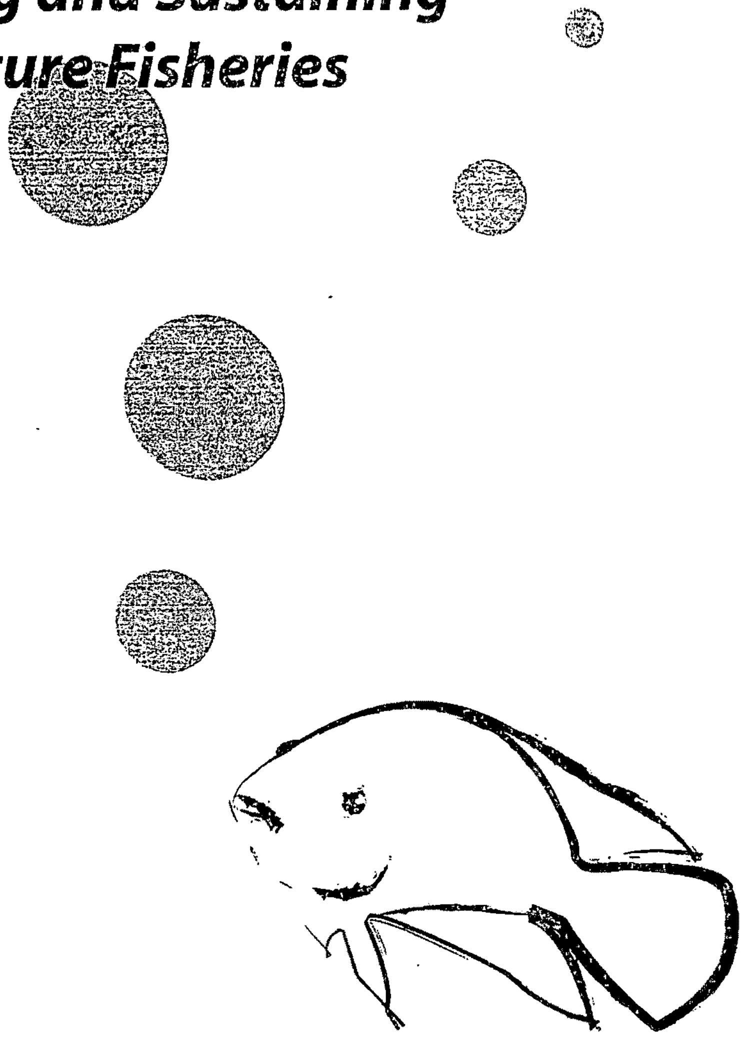
Yield of fish and other aquatic animals from rice fields in Battambang province, near the Tonle Sap Lake, Cambodia (Troeung Roth*, Lieng Sopha, Sam Nuov, Kent G. Hortle) 263

A fisheries baseline survey in Champasak province, southern Lao PDR (Douangkham Singhanouvong*, Kaviphone Phouthavongs, Kent G. Hortle) . 264

Using local fishers to monitor the inland capture fisheries of the Mekong Delta, Vietnam (Doan Van Tien*, Nguyen Van Trong, Lam Ngoc Chau, Kent G. Hortle) 265

Monitoring of fish markets in the Mekong Delta, Vietnam (Hang Kim Trang*, Joseph G. Garrison, Kent G. Hortle) 266

Restoring and Sustaining Capture Fisheries



THE LONG-TERM IMPACT OF COASTAL RESOURCES MANAGEMENT IN PANGUIL BAY, PHILIPPINES

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The study analyzed the long-term impact of coastal resource management (CRM) using Panguil Bay in Mindanao, Philippines as case study. The purpose was to gather data and information useful for future CRM planning and implementation in the country. The study used perceptions of fishermen household respondents, gathered through a survey and measured using a ladder diagram along a 10-point scale, about changes in selected CRM impact indicators as data for analysis.

The study revealed that a) the fishermen in Panguil Bay perceived that their harvest, income and overall well-being have deteriorated in the last ten years when CRM was in implementation and will continue to be so in the next ten years; b) they thought that the well-being of the coastal resources on which they depend on has also decreased in the last ten years and will continue to decline in the future; and c) many of the impact indicators reflecting the institutional changes brought about by CRM have also worsened and will remain so. Assuming that the perceptions of the fishing households were unbiased and the other factors influencing changes in the impact indicators were neutral on the net, the study argued that while CRM in Panguil Bay may have caused some improvements, generally it has failed to attain the long term objectives of improved well-being of fishermen households and the coastal resources in the area.

In conclusion, the study argued that the phenomenal growth of CRM and the large public investment put into it in the Philippines requires the in-depth evaluation of their impact and performance. A constraint to evaluation is the lack of actual data that measure the long-term impact of CRM over time. The study suggested that future activities should develop CRM impact indicators and the variables for their actual measurement as well as monitor and record them.

MANAGEMENT OPTIONS FOR TROPICAL SHAD *Tenualosa* FISHERIES IN SOUTH AND SOUTHEAST ASIA

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All five species of *Tenualosa* are subject to heavy fishing pressure and have suffered major declines. These tropical shads (Clupeidae: *Tenualosa* species) (Terubuk in Indonesia, Terubok in Malaysia, Hilsa in Indian sub-continent, Pba Mak Pang in the Mekong) live in the estuaries and coastal waters of tropical Asia. The most widespread and well-studied species is *T. ilisha,* which is found from north Sumatra in the east to Kuwait in the west, and is the basis of important fisheries in Bangladesh, India, Burma, Pakistan and Kuwait. The closely related *T. reevesii* occurs intermittently along the South China coast and far up the Yangtze, Pearl and Qiantang rivers and *T. thibaudeaui,* only lives in the lower and middle Mekong system. Both the latter species are close to extinction. Once widespread, *Tenualosa toli* is now found only in the estuaries and adjacent coastal areas of Sarawak, while *T. macrura,* lives in the coastal waters of Sumatra and Borneo. *Tenualosa* species exhibit several life history strategies; for example, *T. ilisha* and *T. reevesii* are gonochoristic, whereas *T. toli* and *T. macrura* are protandrous hermaphrodites. Habitat preferences, movement patterns and maximum age also vary between species. Management of *Tenualosa* fisheries varies from complex regulations in some countries to none in others. The suitability and effectiveness of management options for each species is discussed in relation to the life cycles of each species and the socioeconomic environment in which each fishery is operating.

THE TAB: AN EMERGING (SUB-) REGIONAL FISHERIES ORGANIZATION FOR THE MEKONG? WHY WE NEED IT, AND WHAT IT SHOULD DO?

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Regional fisheries organizations (RFOs) are increasingly viewed as "vehicles of good governance" created to safeguard the sustainability of international fisheries (Sydnes 2001, 2002). Most RFOs have been developed to deal with straddling and migratory stocks, and marine fisheries; they are often established after the declaration of Exclusive Economic Zones (EEZs) in the wake of the United Nations Conference of the Law of the Sea (UNCLOS). Though there are a number of RFOs in inland fisheries, there is none in Southeast Asia. They usually are organizations pursuing scientific research, policy coordination and development, fisheries management, or any combination of these objectives and with an exclusive focus on regional fisheries. A great number of RFOs was set-up with support from (or as part of) the Food and Agriculture Organization (FAO), and some in response to international obligations created by important agreements and conventions impending on global and international resources governance, such as the 1995 Code of Conduct for Responsible Fisheries (CCRF). In the 1990s there was a "new wave" (Sydnes 2002) of RFOs with environmental concerns at the forefront. The Technical Advisory Body for Fisheries Management (TAB) is an interesting example for a 'lighter' and more flexible regional/sub-regional initiative in Asian inland fisheries management cooperation.

The TAB was established in 2000 by representatives of the four national fisheries line agencies of the region of the Lower Mekong Basin and respective National Mekong Committees, with the support of the Mekong River Commission (MRC), in line with the agencies' 1995 Agreement on Mekong Cooperation. The TAB has since granted permanent observer status to the [potentially non-governmental] Network of Women and Gender in Fisheries. The emphasis on commissioning studies (through MRC's Fisheries Programme) on the biology and management of migratory species and habitats critical to their maintenance, as well as regional training in fisheries co-management, indicates that, initially, the TAB understood itself as a provider of regional scientific information and capacity-building. More recently however, the emphasis has shifted to convert study results into management policies and action, that is, a shift to the function of regional fisheries policy coordination and development. The TAB is not an intergovernmental organization established to perform specific functions related to international fisheries at a regional level. However, it enjoys privileged links to such intergovernmental organizations as MRC and SEAFDEC.

The paper describes the TAB, its mode of operation and its recently adopted 3-year workplan. It furthermore compares the TAB to a number of other regional inland fisheries organizations, such as EIFAC (Europe), COPESCAL (South America), and LVFO (Africa), and others, emphasizing similarities and differences.

Among the issues highlighted in the paper are: What are the objectives and scope of cooperation? What are the benefits of having the TAB? What are the TAB's present and potential relationship to other global or regional development organizations (e.g. FAO, SEAFDEC, MRC), as well as national management and development agencies? What are its present and possible future tasks and responsibilities? How do exclusive rights to local/national fish resources relate to attempts at transboundary management? To what extent can or should it focus exclusively on regional issues, and what is the importance of the interface between local/global levels, as well as multiple sectors competing for aquatic resource uses of and in the Mekong?

IMPACTS OF IRRIGATION ON FISHERIES IN RAINFED RICE FARMING LANDSCAPES

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Irrigation development is a major threat to freshwater ecosystems and fisheries. To establish the impacts of small to medium sized weir and dam irrigation schemes on fisheries in the rainfed rice farming landscapes, an observational study was conducted in southern Laos. The study was replicated at the irrigation scheme level. Dam irrigation schemes substantially modified aquatic habitats, increasing lacustrine and reducing riverine habitat area, and expanding dry season rice field area. No significant habitat impacts of weir schemes were detected. Irrigation led to declining catches from all habitats except the reservoirs created by dam schemes. These catch declines were related to changes in exploitation patterns rather than a decline in biological production capacity. No significant impacts on fish species richness were detected. The extent of wet season aquatic habitat (principally rainfed rice fields) was a major factor determining village level fish catches. Changes in wet season farming practices are likely to have a greater effect on fisheries than the development of dry season irrigation. Medium scale irrigation schemes in rainfed rice farming landscapes have only moderate impacts on local fisheries, which remain productive and diverse. Agricultural practices in the wet season are likely to have greater effects on fisheries than dry season irrigation. Maintenance of farming practices that are compatible with fisheries will have ecological and social benefits.

PEOPLE AND POLICY CHANGE IN INDIAN FISHERIES

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In the mid 1990's a research project under the DFID Natural Resources Systems Program (NRSP) began working with a large DFID development project called the 'Eastern India Rainfed Farming Project' to consider aquaculture options for people living in remote tribal villages in eastern India. During and after that project some local groups enjoyed success with aquaculture options suitable to people with few resources. A feature of this work was the development of recommendations of how farmers and fishers could use seasonal water bodies for aquaculture. In order to share this learning more broadly, NRSP supported a follow-on project entitled "Investigating improved policy on aquaculture service provision to poor people". The objective was to share farmer and fisher's recommendations with fisheries administration at state and national level to see if any of these might find a place in national guidance and state policies. During the process the viewpoints of farmers and fishers and other stakeholders including GOs and NGOs were sought in the states of Jharkhand, Orissa and West Bengal. There were wide-ranging consultations in villages; a series of workshops at local, state and national levels; and video film documentaries and a live drama developed with groups in villages. All this highlighted some gaps in the support available to poor and rural people and elicited their recommendations for change. These recommendations were then prioritized by state and national government officials through a facilitated consensus-building based on the Delphi technique. Finally, a workshop in Delhi placed prioritized recommendations before policy-makers and representatives of research organizations via statements from farmers and fishers, video and live drama.

Thirteen recommendations that emerged out of the forty posed by the various stakeholders were formally received by senior policy makers. Several of these recommendations are now being piloted in some states, including the extension of the lease period of ponds for aquaculture from 1 to 5-10 years and new ways of communication with fishers and farmers.

This paper outlines the process which sought to give (poor) farmers and fishers a voice in the development and implementation of policies that could support their livelihoods.

DEVELOPING A SYSTEM OF EFFECTIVELY MANAGED MARINE SANCTUARIES IN THE PHILIPPINES: A NATIONAL NETWORK STRATEGY

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Over the past two decades, establishment and maintenance of marine protected areas (MPAs) has become a popular fishery and coastal management technique in the Philippines. There may be well over 600 established MPAs in the Philippines with only 18% of them functional.

Meanwhile, community-based MPA managers, numbering about 60 representing about 33 community-based MPAs in the Philippines, represented by fisher-leaders and village-level local government units, gathered together in 1999 to form a national alliance and called themselves PAMANA Ka Sa Pilipinas Inc. Sixteen months after its formation, strengthening of PAMANA fell within the framework and implementation of Haribon Foundation's project called Building a National Community of Local Coastal Resource Managers (BNC-LCRM) a.k.a. PAMANA Project. The aim is to strengthen national network of MPAs like PAMANA thru capacity building, participatory research and policy advocacy, leading to the development of effectively managed marine sanctuaries. After its 2nd and 3rd National Assembly in 2001 and 2003, it has a new set of elected officers and has set the policy and organizational agenda that is presently charting the organization's activities. At present, PAMANA is active in creating a more conducive policy environment related to fishery and MPA management and coastal management in general. Policy advocacy carrying national and local issues are being conducted both at the national and local levels and at the same time creating opportunities for PAMANA ecosystem based organizing and networking activities. On the other hand participatory research and trainings are being done primarily with the use of participatory marine sanctuary monitoring tools as part of membership development services.

Significant lessons have been building up since PAMANA' conception, currently numbering about 122 member sites clustered around 22 baywide sites across the country, and that includes areas such as national alliance building, policy advocacy, participatory marine sanctuary monitoring and training, and MPA and fisheries management.

AN ARIMA (0, 1, 1) MODEL AND BOOTSTRAP ESTIMATION FOR FORECASTING THE ANNUAL TOTAL MARINE FISH PRODUCTION IN MALAYSIA

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Malaysia is surrounded by the Straits of Malacca, the Straits of Johore, the South China Se and the Sulu Sea which are a rich source for marine fisheries. The fishing industry is a important economic activity and the total marine fish production has increased fro 242,900 tons in 1970 to around one million tons in the year 2000.

Since, fisheries resources are renewable, proper management issues need to be taken manage these resources. From the management point of view, fish forecasting is a ve important tool for fisheries managers and scientists to enable them to decide on sustainab management issues.

Time series models have been used to forecast various phenomena in many fields lik economics, business, meteorology, tourism, etc. One class of time series models are th ARIMA models and usually the parameters of these models are estimated by the maximu likelihood method. This method is usually done under the Gaussian assumption. Recentl there has been some research indicating that the Bootstrap estimates are comparable t maximum likelihood estimates.

Therefore, in this research we fit time series models to forecast total Malaysian marine fis production, both by the maximum likelihood and bootstrap method. In particular, w examined the bootstrap estimate generated for the total marine fish production in Malays from 1960 to 2001 to observe the effectiveness of this method. We also compared th bootstrap estimate to the corresponding maximum likelihood estimate generated for th same dataset. Furthermore, we predicted the total marine fish production for 10 years.

Our results indicate that the ARIMA (0,1,1) model appears to be an appropriate model fo modelling total marine fish production. The model was able to pass through variou validation tests such Ljung-Box, McLeod-Li, Rank test, etc. The bootstrap estimates wer found to be comparable to the corresponding maximum likelihood estimates. Based on ou model the forecast shows approximate linear increase and in the year 2010 it is estimate that the total marine fish production would be about 1.3 million tons. Whether or not th amount would be able to meet the needs of a growing population needs to be addressed.

POTENTIAL ACCESS RIGHTS AND GOVERNANCE OF THE COASTAL POOR COMMUNITIES FOR HARVEST AND CULTURE OF MOLLUSKS IN BANGLADESH COAST

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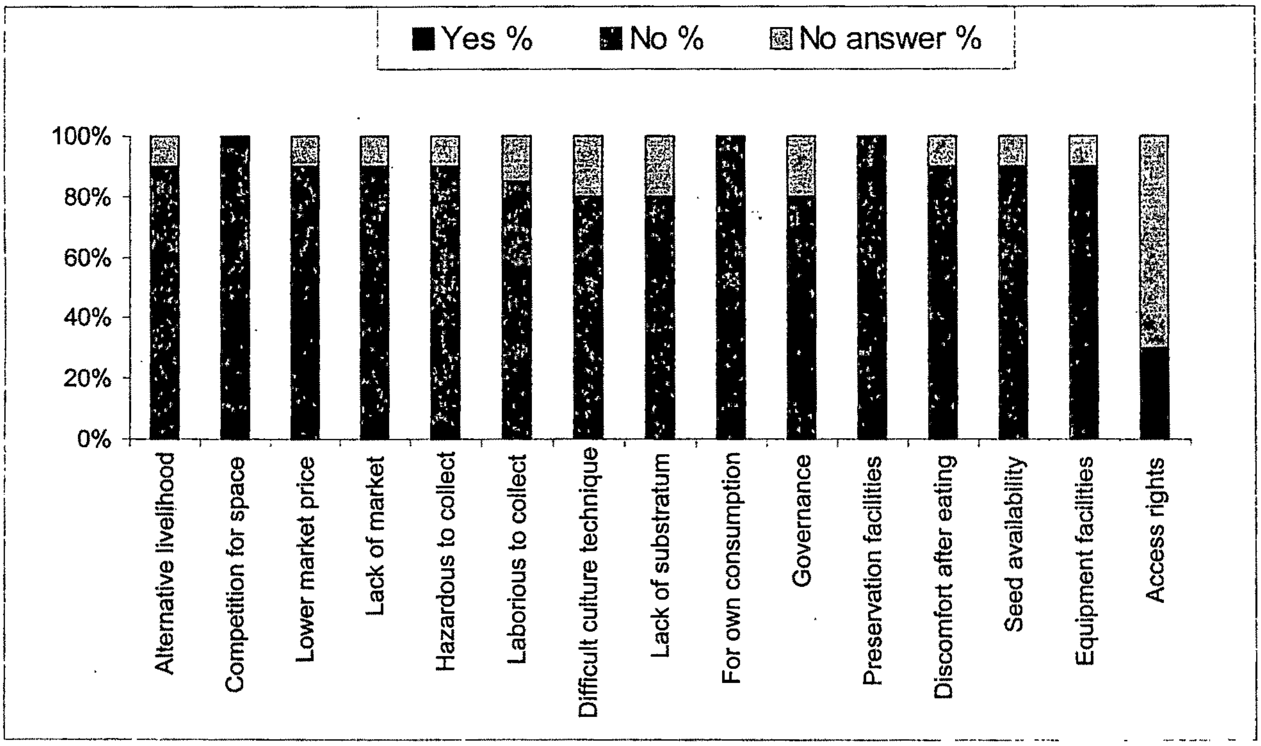
The Rakhaine, a tribal community in the coastal districts collect and consume mollusks. Non-tribal people collect it for using in the preparation of poultry feed and lime. Due to rapidly increasing population, resource limitation, water pollution and mangrove clearance mollusks are becoming scarce. A study has been conducted using different PRA tools such as focus group discussion (FGD), personal interview using questionnaire with farmers (n = 30) in Satkhira and Cox's Bazer coastal region of Bangladesh to identify the problems, access rights and governance to beset the culture and harvest the mollusks. About 80% respondents harvest mollusks for their own consumption. Rest of the respondents harvest mollusks for partial consumption and partial selling to the community. Conversely, all of the non-tribal mollusk collectors use only the shell for poultry feed and lime (popular item chewed with betel leaf) preparation. Several problems hindered the initiation of mollusks culture in the coast such as lack of technical know how, seed, money, access rights and good governance. Other problems are pertinent to lack of demand of mollusks as seafood in the mainstream non-tribal people, marketing, culture techniques, suitable water-bodies etc. According to most of the respondents farming of mollusks in the coast of Bangladesh may be possible but it will not sustain if local and overseas marketing is not initiated.

Figure1. Views of the interviewed respondents about the problems, access rights and governance to beset the culture and harvesting the mollusks in Bangladesh.



IDENTIFICATION OF SIMPLE INDICATORS OF ECOSYSTEM HEALTH AND EXPLOITATION STATUS IN THE SHRIMP FISHERY IN SOUTH VIETNAM

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In order to identify simple indicators of ecosystem health and exploitation status for the shrimp (*Panaeidae* spp) resource in South Vietnam, 16 open ended interviews were carried out with stakeholders from four coastal villages in Ca Mau province. These in dept interviews resulted in a list of 45 statements that were divided into three subgroups relating to 1) shrimp distribution and migration patterns, 2) habitat factors and preferences and 3) abundance. The statements were used for a consensus analysis among a larger number of offshore and near shore fishers and the level of agreement within and between the two stake holder groups were estimated to identify the local ecological knowledge (LEK).

Based on enumerator catch and effort data covering the period 1996-2002 the LEK of the two stakeholder groups was compared to the scientific information with particular focus on the abundance statements and the degree of agreement evaluated.

BOOM AND BUST FISHERIES IN THE PHILIPPINES: MONITORING A NEW SEAHORSE FISHERY IN NORTHERN BOHOL FOR MANAGEMENT INSIGHTS

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A "boom and bust" fishery in which a newly discovered population of the seahorse *Hippocampus spinosissimus* was rapidly exploited for use in traditional medicines resulting in an eventual collapse was monitored. From June 2003 to January 2004, daily monitoring of landings was conducted to assess the health of the fishery and the status of the seahorse population. The seahorse fishery which initially supported 10-11 fishing vessels declined rapidly to such low catch levels that by October only 3 vessels bothered to target seahorses. By October, total monthly catch had declined by 90% from the level recorded in July, the first full month of monitoring. Total catch remained low between October and January at less than 10% of the peak value. The decline in total catch was related to both declining seahorse abundance, and a decline in fishers targeting seahorses related to the lower seahorse abundance. Catch per unit effort (calculated as seahorses per fishing vessel per day) declined 60% between June and January for those boats assumed to be targeting seahorses. Analysis by fishing ground showed evidence of serial depletion from August to January; CPUE declined rapidly at multiple fishing sites following one or two large extractions.

The monitoring clearly documents the rapid decline of an over fished population of *H. spinosissimus* to below economic viability for most fishers within a few months. This case study illustrates the need for proper management in the early stages of opportunistic, boom and bust fisheries. Proactive community-based management options to control exploitation (e.g. catch or effort regulations, spatial closures) are needed to allow fisheries of this nature to operate sustainably. However, such measures, without access restrictions, are unlikely to be successful. Under an open-access fishery the race to catch and sell the product will inevitably lead to a fishery collapse.

POPULATION DYNAMICS AND SOME ASPECTS OF BIOLOGY OF HILSA *Tenualosa ilisha* IN BANGLADESH AND ITS MANAGEMENT STRATEGIES

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Hilsa (*Tenualosa ilisha*) the national fish of Bangladesh contributing about 13% of the country's total fish production (1.5 million mt). More than 2% population of the country is dependent on this largest single species fishery. This diadromous fish attain maturity in the sea and then undertake upstream migration to the rivers for breeding. In recent years, the production from inland section is decreasing gradually. This decline in abundance of hilsa is due to many reasons among which indiscriminate killing of *jatka* (juveniles of hilsa) of upstream waters and overexploitation of adults during breeding migration are considered as main factors. Some other factors are also causing the declination of hilsa production in Bangladesh such as degradation of nursery and breeding grounds, use of destructive fishing gears, reduced discharge of rivers water due to siltation of river basin and pollution of water, and weakness in implementation of fish conservation law, etc. The adult and sub-adult hilsa are plankton feeders. The peak spawning period is September-October with a minor peak in January-February. Fecundity of hilsa in Bangladesh is now on a declining. The hilsa population of Bangladesh is being over fished alarmingly. However, based on the research results, major aspects of feeding and breeding biology are known, and also nursery grounds have been confirmed and hilsa sanctuaries are being established, and thus the Government of Bangladesh has banned indiscriminate killing of *jatka*. Finally, a Hilsa Fishery Management Action Plan (HFMAP) has been formulated and is being implemented. The important aspects of hilsa biology in Bangladesh and its management strategies are discussed in the paper.

STATUS AND MANAGEMENT OF FISHERIES IN THE SUNDARBAN MANGROVES OF BANGLADESH

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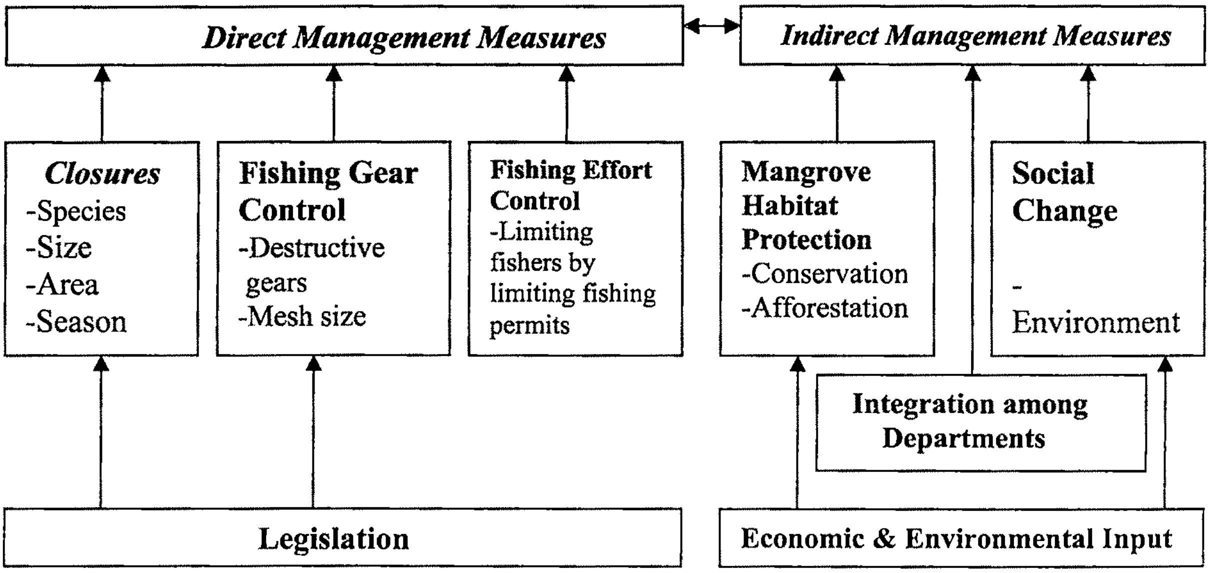
The Sundarban is the main natural mangrove wetland of Bangladesh and has been formed in the estuary of the river Ganges along the coast of the Bay of Bengal. It is considered an important ecosystem, due to its exceptional productivity and enhanced role in providing protection for juveniles against predation. Fish in the Bay of Bengal rely on the Sundarban mangroves as a nursery for their young life stages but the area also provides a physical habitat for many large fishes. Its aquatic resources are an important component of its biodiversity and are important source of food and income for the large population.

Sundarban supports both artisanal and commercial fishery of which the later is more important but operates only during October to February due to weather conditions. Over 200 species of finfish and shellfish of the Sundarban wetland are harvested by approximately 155,000 artisanal and commercial fishers with non-mechanized and mechanized fishing boats. There are 16 different fishing methods and gears used by the fisher, that are clustered into three interesting major groups based on target species and fishing gears. Shrimp post larvae fishing in particular is considered to be very destructive.

The management of the Sundarban has been mainly related to the forestry aspects since 1879, but the value of its aquatic resources had not been adequately realized and no attempt has been made so far for the proper management and conservation of aquatic resources. Fishery is managed by issuing permits to the interested fishers for realizing revenue only. Thus, an excessive fishing effort on fish stock has increased the stock removal beyond a sustainable level. As such, there are many threats to the fishery and lower yield. This paper reviews the status of the Sundarban mangrove fishery and discusses the management and conservation needs of the area. It also catalogues the threats to this system and indicates probable management and conservation measures needed to develop the fishery in a sustainable way.

Figure 1 Proposed management measures for the Sundarban fisheries


Direct Management Measures
Indirect Management Measures
Closures
-Species
-Size
-Area
-Season
Fishing Gear Control
-Destructive gears
-Mesh size
Fishing Effort Control
-Limiting fishers by limiting fishing permits
Mangrove Habitat Protection
-Conservation
-Afforestation
Social Change
- Environment
Integration among Departments
Legislation
Economic & Environmental Input

USE OF INDIGENOUS TECHNICAL KNOWLEDGE IN INDIAN FISHERIES

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Indigenous Technical Knowledge (ITK) is the sum total of knowledge, skill and practices of the local peoples derived from their interaction with environment. The rich and diversified culture of India provides a valuable storehouse of traditional knowledge which is unique to a given culture or society. In the present scenario of deteriorating agro-ecological situations and declining productivity, ITKs are gaining importance in India as alternative methods for sustainability. ITKs prevailing in fishery sector were identified in few selected villages of West Bengal state of India through Participatory Rural Appraisal) method using group discussion and direct observation as tools. During discussion, local knowledge, believes and practices were appreciated and interest was shown in knowing these. Few widely practised ITKs in fisheries are listed below.

- Application of banana pseudostem in fishpond to improve water quality and check fish mortality.
- Broadcasting of ash (of freshly burnt paddy straw) in fishpond to check disease outbreak in fish.
- Use of mixture of lime and neem (*Azadirachta indica*) leaf powder (2:1ratio) to control disease in fish and prawn.
- Application of mixture of neem oil and turmeric powder on wounds of fish.
- Use of garlic paste as feed additive to enhance the immune function in fish and shrimp.

FISHERIES MANAGEMENT OF BONY FISHES IN THE IRANIAN WATERS OF THE CASPIAN SEA

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The bony fish beach seine fisheries of the Iranian coastal water of the Caspian Sea are commonly managed by a policy that involves annual catch quotas on individual species, which set the overall levels of harvest of some commercial species.

The catches of bony fish species (The Caspian Sea kutum *Rutilus frisii kutum*, mullets *Liza aurata* and *Liza saliens*, bream *Abramis brama orientalis*, pickperch *Stizostedion lucioperca*, common carp *Cyprinus carpio*, barb *Barbus capoeta*, asp *Aspius aspius*, shads *Alosa sp.*, Sea trout *Salmo trutta caspius*) have fluctuated during past decades due to overfishing, pollution, deterioration of the spawning grounds of anadromos species, and decreases in the level of the Caspian Sea. But during the two recent decades, the overall catch of bony fishes has increased from 2500 tonnes in 1983 to 15,000 tonnes in 2002. Most of this increase is from increasing the catch of Caspian Sea kutum by stocking 2.5 billion. Greater catches of mullets has also contributed to this increase.

On the other hand invasion of Atlantic comb jelly to the Caspian Sea had some adverse effects, particularly on Kilka, in this area and decreased the catch of these species from 85,000 tones in 1999 to about 23,000 tones in 2002. We predict that this invader will also have some dramatic effects on benthophagic species by decreasing the biomass of zooplankton and benthic organisms.

COMMUNITY BASED FISHERIES MANAGEMENT IN THE COASTAL AREA OF BANGLADESH: A CASE STUDY

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This is a vogue to do fish farming in a pond or other water body inside and outside of the household in rural scenario of Bangladesh as an agriculture-aquaculture farming for a long time. Even the fish farming with profit or income generation among the fish farmers has taken place just few years ago with the initiative of many development projects. The Government of Bangladesh had launched 'Patuakhali Barguna Aquaculture Extension project (PBAEP) in south and south east coastal area of Bangladesh which is supported by DANIDA (Danish International Development Agency) through its Technical Assistances in cooperation with the Department of Fisheries (DoF) of the Ministry of Fisheries and Livestock (MoFL), Bangladesh and implemented by 2 local NGOs. This project aims during 1997-2004 to strengthen the socio economic status and physical well-being of the men and women and improve their participation in social and economic development as well. The project emphasis on community based fisheries management (CBFM) in coastal area through Integrated Pond Farming (IPF) activities. Training for IPF is the sole intensive system to the farmers group so that they can do raising fish and use the dyke of the pond and be beneficial from earning money with the increase of production. The paper was to obtain qualitative information of farmer's attitude, perception and opinions, including both their positive and negative experiences to identify opportunities and constraints to raising fish from the women farmers in particular. It is found through a field study at the project area that the women play an important role in Integrated Pond Farming activities; nevertheless, women ability to exercise a choice in terms of agency is much lower. The project stresses on development of primary capabilities for the first for women with aquaculture techniques and micro credit training respectively, the project built up these women community significantly. The research findings concludes with the recommendation to provide credit, form sex separate groups and the extensive gender training for extension worker while women are less confident to speak up in the presence of their male partner in the training and meeting conducted by the project, fish farming is quite expensive for the rural women group and the extension worker.

Table 1. Women ability to *exercise a choice through access and control over resources

Respondent's Category	Access (resources) (N= 30, female= 15, female= 15)								Control (resources) (N= 30, male =15, female=15)							
	Land		Money		Equipment		Time		Land		Money		Equipment		Time	
	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%
Male	15	50.0	12	40.0	10	33.9	14	46.6	15	50.0	15	50.0	10	33.9	14	46.6
Female	4	13.3	3	10.0	2	6.6	3	10.0	2	6.6	2	6.6	1	3.3	3	10.0
Total	19	31.5	15	25.0	12	20.5	17	28.6	17	28.6	17	28.6	11	18.5	17	28.6

BIOLOGY OF *Gudusia chapra* IN A COMMUNITY MANAGED NATURAL RESERVOIR IN BANGLADESH AND THE IMPACTS OF THE FISH ON THE NUTRITION OF THE ADJACENT POOR

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Feeding and breeding biology, some population parameters and contribution to homestead nutrition of a self recruiting small indigenous fish chapila, *Gudusia chapra* dominant in a natural reservoir of 53 ha in Netrokona, Bangladesh were studied over a period of 12 months from January 2003 to December 2003. The reservoir is managed by the poor fishing community under community based fisheries management policy of the country. The historical catch data revealed that the annual fish production of the beel fluctuated between 5.95 mt to 13.4 mt during 1997 to 2003, and this fluctuation was mainly due to the fluctuation of *G. chapra* catch. The livelihood survey following Participatory Rural Appraisal (PRA) showed that the large sized fishes (e.g. major carps, catfishes etc.) are completely sold to fish traders for different cities while small fishes, mainly *G. chapra* are either distributed among the fishers for home consumption or sold among the local communities who normally do not have capability to buy large fishes or sold to the fish traders. The poor communities living adjacent to the reservoir are worried of declining production of *G. chapara.*. The results of PRA as well as the catch data also indicated decline in biodiversity of different small indigenous fishes. The gut content analysis of *G. chapra* showed that it is a plankton feeder, consuming chlorophytes, cyanophytes, bacillariophytes, euglenophytes, rotifers, and crustaceans as their food items. The Gonadosomatic index (GSI) and the histology of gonads revealed that the fish spawn during February to August in the reservoir but the main period of spawning is during March. The rate of exploitation indicated overfishing condition during the study period. To get sustainable *G. chapra* production from the beel the present research suggests that the fish should be stopped during the main breeding period.

STEPS TOWARD SUSTAINABLE FISHERIES IN THE WEST AND CENTRAL PACIFIC

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The waters of the west and central Pacific Ocean account for more than 40% of the world's tuna catch. Much of the catch occurs within the Exclusive Economic Zone (EEZ) of the over 20 countries and territories in the Pacific. The fishery includes a purse-seine fleet that targets small fish primarily skip jack tuna (*Euthynnus pelamis*) and a long line fishery targeting large fish primarily albacore (*Thunnus alabunga),* big-eye tuna (*T. obesus),* and yellow fin tuna (*T. albacares*). The fishery is primarily a medium to large-scale industrial fishery pursued by fishing boats based locally and from Distant Water Fishing Nations (DWFN).

The costal states in the Pacific in most cases are small in land area but have large EEZs. They have very limited capacity in fisheries research and management. In the past 25 years spearheaded by the regional inter-governmental agencies the Forum Fisheries Agency (FFA) and the Secretariat of the Pacific Community (SPC) there have been various approaches to strengthen both in-country and regional research and management of the highly migratory tuna fisheries and attempts to return more of the resource rents to the coastal states.

This paper describes the approaches to sustainable management that have been applied to the west and central Pacific including both regional and in-country approaches. Specific details are given on the development of in-country tuna management plans. An assessment of the success and failure of a number of the plans suggests that factors key to success are the degree of importance of the resource to the country and the degree of political will to implement and enforce difficult management decisions.

As the new West and Central Pacific Tuna Commission comes into effect a number of new challenges are emerging. These challenges are further elaborated in the paper and include:

- Limits on capacity while increasing economic returns to coastal states;
- Determination and allocation of Total Allowable Catch (TAC) both at the regional and country level;
- Greater detail on the fine scale fish movements and effects of oceanographic conditions;
- Management of interactions between species and regions;
- Improvements to the vessel monitoring and surveillance systems to combat illegal, unreported and unregulated fishing;
- Implementation of improved in-country legal systems;
- Management of by- catch of endangered and other species; and
- Management of the fishery for small fish in Indonesia and Philippine waters.

Solutions will require a greater unity and solidarity among the coastal states but also closer cooperation with the DWFN's.

ESTIMATING GENETIC DIFFERENTIATION AND CONNECTIVITY AT NESTED SPATIAL SCALES USING MICROSATELLITE MARKERS: EXAMPLES FROM TWO CORAL REEF ASSOCIATED SPECIES WITH CONTRASTING PELAGIC LARVAE DURATION AND ADULT BEHAVIOR

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Genetic studies, particularly those that use microsatellite markers, have the potential to assist in defining natural stock boundaries at small scales because of their high levels of variability, co-dominant inheritance, short lengths and ease and reliability in gathering data from a large number of samples. Model based analytical and statistical procedures have been developed to use this wealth of genetic information innovatively or to improve on traditional population genetics models. However, the current examples of their applications to marine finfish, are limited to temperate and sub-tropical species many of which are migratory or anadromous.

We evaluate the utility of 10-11 microsatellite markers to detect genetic differentiation among two reef associated tropical fish species from 24 sites in the South China Sea, the Philippines and in the Bohol Sea in central Philippines. The hierarchical sampling design allows us to determine thresholds in the number of loci and alleles required to detect population structure. Measures of genetic variability, estimates of genetic differentiation and connectivity are compared for the same species at sites 10-10,000 km apart. Maximum-likelihood, the coalescent and Bayesian statistical approaches were applied to obtain more detailed inferences on population parameters such as migration rates, effective population sizes and intra and inter-locus disequilibrium. The species examined, *Dascyllus trimaculatus* and *Caesio cuning* have contrasting reproductive strategies, pelagic larvae duration and adult behavior representative of the spectrum observed in coral reef fish. Thus, a comparison between estimates of differentiation and population parameters between the two species provides some indication of the applicability of this approach to other reef-associated species.

Table 1 Comparison of estimates of genetic variability of *Dascyllus trimaculatus* at different spatial scales based on six microsatellite markes

	South China Sea	Philippines	Bohol Sea
Spatial scales	~10,000 km	~1,000 km	~500 km
No of sites in each area (exclusive of the nested sites)	11	5	8
Average diversity estimates (H_e)	0.569 ± 0.010	0.554 ± 0.008	0.580 ± 0.011
Avererage population differentiation (F_{st})	0.178 ± 0.031	0.093 ± 0.0.004	0.057 ± 0.003
Average number of alleles	6.8 ± 0.2	6.4 ± 0.3	6.0± 0.6

GENETIC VARIATIONS OF THE SHRIMP *Penaeus chinensis* BASED ON RFLP OF MITOCHONDRIAL CONTROL REGION

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Penaeus chinensis is a commercially important species in Korea and northern China. Studies on genetic diversity would provide information for conservation and genetic improvement of the species. Previous studies based on mitochondrial 16S rRNA and cytochrome oxidase I analysis revealed low levels of genetic differentiation among *P. chinensis* populations. As these two genes are relatively conserved for population analysis, we report here results on genetic variations of *P. chinensis* based on the highly variable mitochondrial control region.

Specimens of *P. chinensis* were collected from the west coast of the Korea Peninsula (Narodo Island, Heuksando Island and Youngkwang) and the Chinese coast of the Yellow Sea (Qingdao, Tianjin and Dalian). Based on sequences of a 613-bp PCR product from the 5'-end of control region, substitutions generating RFLPs were identified. Despite the higher genetic variations revealed as compared to previous studies, we failed to detect consistent genetic differences among the populations studied based on the restriction pattern of *RsaI*, *AccI* and *Hsp92II* (Table 1). The high level of gene flow may be due to the strong migratory and larval dispersal ability of this species. In conclusion, results of our study confirm the lack of genetic differentiation among *P. chinensis* in the Yellow Sea.

Table 1 Frequency distribution of control region haplotypes among *Penaeus chinensis*

Haplotype	Qingdao	Tianjin	Dalian	Youngkwang	Narodo Is.	Heuksando Is.	Total
1 ABA	1(3.4%)			1(2.9%)	1(8.3%)	1(6.3%)	4
2 BAA				2(5.7%)		1(6.3%)	3
3 BBA	27(93.1%)	10(83.3%)	14(77.8%)	32(91.4%)	9(75.0%)	14(87.5%)	106
4 BBB		1(8.3%)	2(11.1%)		2(16.7%)		5
5 BBC	1(3.4%)		2(11.1%)				3
6 BCA		1(8.3%)					1
n	29	12	18	35	12	16	122

EFFECT OF INVASION OF *Mnemiopsis leidyi* ON PELAGIC FISHERY IN THE CASPIAN SEA

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Comb jellies comprise a diverse phylum (Ctenophore) of delicate, gelatinous species living throughout the world's oceans. In estuarine and coastal waters ctenophores can reach suddenly great abundances. *Mnemiopsis leidyi* is one of the most carnivorous species among them. *M. leidyi* was seen in the Caspian Sea in spring 2000, but a warning that it might also enter in to the Caspian Sea, was announced as early as 1995. *M.leidyi* probably was introduced from Azov-Black Sea through Volga-Don canal with ballast water of vessels.The native habitat of ctenophores of the genus *Mnemiopsis* is in estuaries along the eastern coastline of north and South America. It has spread from the Black Sea to the Seas of Azov, Marmara and eastern Mediterranean. Its has created serious problems for the ecosystems of most of these basins. At the end of 1990s, it invaded the Caspian Sea. Most probably that this ctenophore was transported with ballast water taken aboard in the Black Sea or the Sea of Azov. The impact of *Mnemiopsis* on the Caspian Sea ecosystem may be much worse than in the Black Sea due to greater sensitivity of this closed basin. Since *Mnemiopsis* is a voracious predator on zooplankton both abundant small pelagic fish feeding on zooplankton as well as large predators on these fish such as white sturgeon (*Huso huso*) and endemic Caspian seal (*Phoca caspica*) would be under significant threat in the Caspian Sea. Recent investigations showed that *Mnemiopsis* was distributed mainly in the middle and southern Caspian Sea. Following the invasion of *M.leidyi,* sharp decline was observed in the pelagic, mainly Kilka (*Clupeonella spp.*) fishery of Iran, Azerbaijan, and Russia.

The total catches of Kilka in Iranian waters declined by 83% during 1999 and 2003. The sudden decrease in Kilka landings is also seen in the fisheries of other Caspian coastal countries. For example, Kilka catches for the Russia, Azerbaijan, Kazakhstan, and Turkmenistan also dropped..

P23649

POPULATION STRUCTURE AND GENETIC LINKAGES AMONG *Caesio cuning* POPULATIONS IN MALAYSIA AND ADJACENT REGIONS

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For countries surrounding the South China Sea, many reef-associated species are likely to be shared stocks. Where this is the case, coordinated management efforts between countries and jurisdictions are vital to avoid over-exploitation of the resources in the region. Knowledge acquired through studies on population structure and genetic linkages will guide the process of developing joint management in the area.

Use of ten hypervariable microsatellite markers to evaluate connectivity among six populations of *Caesio cuning* from selected coral reefs in Peninsular Malaysia, East Malaysia, Indonesia, the Philippines and Vietnam is described. *C. cuning,* also known as the 'red belly yellow tail fusilier', is a reef-associated, non-migratory species that inhabits offshore reef slopes of tropical marine waters of Indo-West Pacific. It is a commercially important food fish harvested by both small scale and commercial fisheries throughout the South China Sea. These attributes make *C. cuning* an ideal species to examine for connectivity studies. Microsatellites markers are highly variable while short DNA sequences which are co-dominantly inherited are easily scored. These markers may provide indications of gene-flow and connectivity over small temporal and spatial scales.

Screenings of the ten hypervariable microsatellite markers show variability of up to 4 alleles per locus. DNA extractions were carried out on all fish samples and PCR was performed for ten microsatellite markers for every sample in each population. Genetic variability and differentiation were then estimated through population genetic models. Subsequently, statistical tests to determine the presence of hierarchical regional structuring among sub-populations were conducted. Connectivity was then determined through usage of Bayesian clustering approaches designed for microsatellites. Results from genetic analyses were compared with structures obtained from morphometric analyses of the same individuals to determine the extent of connectivity among the different populations of *C. cuning*.

SOUTH AND SOUTHEAST ASIAN SEAS: LINKING RESOURCE AND SOCIO-ECONOMIC ASSESSMENT WITH MANAGEMENT

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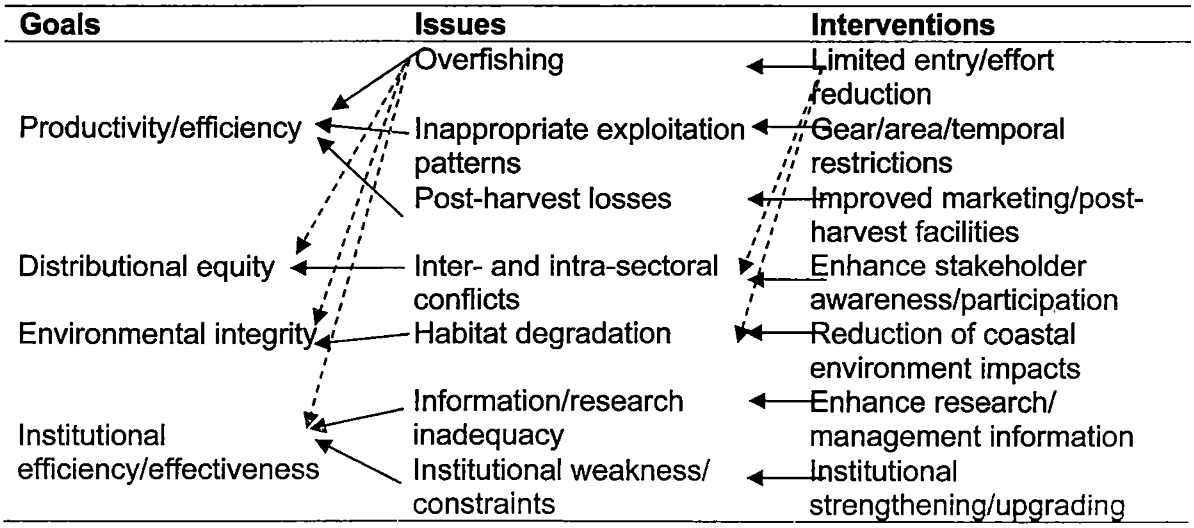
Restoration of capture fisheries is critical to meeting increasing regional and global demand for fish. However, the strategies to achieve this must be based on integrated assessments of the resource (or stocks), social and economic aspects of the fisheries and the broader governance and policy environment. These aspects were examined in a recent regional project, covering coastal fisheries in Bangladesh, India, Indonesia, Malaysia, Philippines, Sri Lanka, Thailand and Vietnam. The resource assessments showed drastic declines (over 95% in some areas) in the biomass of demersal stocks compared to the levels prior to the expansion of fisheries. The exploitation ratios (fishing mortality/total mortality) of species were also high (mean 0.59), indicating severe over-fishing. The socio-economic assessment of the fisheries dependent on these resources highlighted the importance of the sector to local communities in terms of food security and livelihoods. At the national level fisheries provide valuable export earnings. The differences between the commercial and small-scale sector were also highlighted, particularly in terms of employment, demographics and income.

Most countries have key fisheries and environmental policies in place. However, successful implementation of these policies is often hampered by governance issues and by weaknesses in operational level objectives. A key issue is the fact that most fisheries are still effectively open-access with few effective property rights and excess fishing capacity. Based on the resource, socio-economic and policy assessments, each country identified the issues and opportunities in relation to coastal fisheries through consultative national workshops. This resulted in national action plans and a regional plan to support these initiatives. Table 1 summaries the goals, key issues and opportunities that were common across the countries.

Table 1 The key goals for coastal fisheries management and some key issues and interventions. Many of the issues will influence several goals, and interventions may address more than one issue, examples of this are shown by the dotted lines.



Goals	Issues	Interventions
	Overfishing	Limited entry/effort reduction
Productivity/efficiency	Inappropriate exploitation patterns	Gear/area/temporal restrictions
	Post-harvest losses	Improved marketing/post-harvest facilities
Distributional equity	Inter- and intra-sectoral conflicts	Enhance stakeholder awareness/participation
Environmental integrity	Habitat degradation	Reduction of coastal environment impacts
	Information/research inadequacy	Enhance research/ management information
Institutional efficiency/effectiveness	Institutional weakness/ constraints	Institutional strengthening/upgrading

SPATIAL PATTERNS IN THE ASSEMBLAGE STRUCTURE AND TEMPORAL TRENDS IN SPECIES COMPOSITION OF DEMERSAL RESOURCES IN SOUTH AND SOUTHEAST ASIA: A PRELIMINARY ANALYSIS

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An overview of the fish assemblage structure of demersal resources in South and Southeast Asia is provided. Multivariate techniques (classification/cluster and ordination analysis) were used to analyze resource (trawl) survey data in the region. Results indicate that spatial patterns of demersal assemblages are mainly influenced by depth (Fig. 1). Demersal resources in Malaysia, for example, showed assemblage boundaries at around 40m and 90m depth. This is consistent with the limited number of assemblage structure studies conducted previously in the region. The critical implication of this spatial structure for fisheries management is the relationship to management zones. The spatial fisheries management measures in the region (e.g. 15-km delineation in the Philippines and the fishing zones in Malaysia) are largely inconsistent with the assemblage structure patterns observed. The delineation of management zones to partition fishing effort should take into account the spatial patterns of resources, in order to manage the overall impact from different fisheries or sectors.

Temporal changes in species composition of the coastal fishery resources as a consequence of massive declines in resource biomass were also examined. Percentage composition data from the west coast of Peninsular Malaysia from 1920s to late 1990s generally showed that larger, more valuable species have declined in relative abundance while the small species and generalists have increased in relative abundance. Further, whether "fishing down the food web" trends are evident in fishery dependent and independent date was examined.

FIGURE 1 Summary of the major fish assemblage boundaries observed from assemblage structure analysis in south and Southeast Asia. (Note: light shading depicts shallow assemblage while dark shading means deep assemblage; depth ranges with no shading are not covered by the survey or analysis)

Coastal Areas (Source)	Major assemblages (by depth range - meters)									
	<10	20	30	40	50	60	70	80	90	>100
Indonesia – North coast of Java (Nurhakim, 2003)	▨	▨	■	■	■					
Gulf of Thailand (Khongchai et al. 2003)	▨	▨	▨	■	■					
Philippines – San Pedro Bay (Campos 2003)	▨	▨	■	■						
Philippines – Samar Sea (Campos 2003)	▨	▨	▨	■	■	■	■	■	■	■
Malaysia (Alias, 2003)	▨	▨	▨	▨	■	■	■	■	■	■
Brunei Darussalam (Silvestre et al. 2003)	▨	▨	▨	▨	▨	■	■	■	■	■
Bangladesh - Bay of Bengal (Mustafa, 2003)	▨	▨	▨	▨	▨	▨	▨	▨	▨	■
Philippines – Manila Bay (Campos, 2003)	▨	▨	▨	■	■	■				

HISTORICAL CHANGES IN THE FISHERIES RESOURCES OF THE EAST COAST OF PENINSULAR MALAYSIA

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This paper provides an overview of the historical trends in the status of coastal fisheries resources on the east coast of Peninsular Malaysia. The results provide a measure of the changes that have occurred, the current status and future directions for management. The analysis is based on both fisheries dependent and independent data. Annual catch and landings data from the annual fisheries statistics (1981 – 2001) provide information on the trends in the fisheries. The fisheries independent data come from research trawl surveys conducted between 1926 and late 1990's. The combination of both types of data allows the analyses to separate changes in the composition and state of the resource, from changes in fishing techniques and markets.

The fisheries on the east coast of Peninsular Malaysia catch a high diversity of species. However, pelagic fish dominate the catch, followed by other fish and then demersal fish. Cephalopods exceeded the prawn fishery and have doubled in their contribution to the catch since 1981 (1981-88: 4% and 1989 – 2001: 8%). The analyses focused on temporal and spatial trends in catch rates, biomass and exploitation ratios. The changes in the trophic level of the catch and composition of the community were also examined. The results suggest that significant changes in the demersal resources have occurred over the time period examined. Management plans for the region can use these analyses as a baseline for setting future directions for the fisheries.

TAGGING OF *Litopenaeus vannamei* BY TAIL-CUTTING

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Juvenile (mean weight: 1.77 ± 0.5 g; mean carapace length, CL: 14.82 ± 1.2 mm) and sub-adult (mean weight: 18.7 ± 0.2 g; mean CL: 28.9 ± 0.2 cm) *Litopenaeus vannamei* were used in two separate experiments. They were stocked in 0.5 T tanks (30 pcs./tank) with recirculating seawater (salinity 30-32 ‰; 24.5-32.0°C). Two tail-cutting methods were used and compared: a) cutting half of the left outer uropod (HL) and b) cutting the whole right uropods (WR). The cut part was dipped in 10% iodine solution before the shrimp were put into the tanks. Shrimp with uncut uropods served as controls for both size groups. The shrimps were then reared for four months under the condition described above. Regeneration of the uropods was observed weekly during the first month, then monthly thereafter. Regeneration of uropods in juvenile shrimps commenced within 1 week of culture and complete regeneration was evident after 2 weeks. With WR treatment, regenerated uropods were of normal type (N). With HL treatment, abnormal growth (91.1%) was observed including hollow-type (HT; 77.8%) and flat-type (FT; 13.3%) (Table 1). With average final weights of 18-19 g after 4 months of culture, tag retention rate was 87.5%. Survival rate was high (about 98%) for both cutting methods. In sub-adult shrimp, incomplete regeneration was observed within 1 month of culture with both cutting methods. Complete regeneration was observed in 2 months among HL shrimp, with 87.6% showing abnormal growth (Table 1). HT (68.8%) and FT (18.8%) were also observed. With WR, normal growth (with less pigmentation, 5.2%), incomplete regeneration (IG; 26.3%) and abnormal growth (AG; 68.5%) were observed. Abnormal growth was characterized by tubercle-like growths with no definite pattern. Tag retention rate for both cutting methods was 100% after 4 months of culture (final weight: 22-24 g). However, survival rate was low (53-63%). Results from this study showed that cutting of uropods is a good method to induce abnormal growth for biological tagging with high retention rates in *L. vannamei*. Cutting half of the outer uropod (HL) can be successfully applied to juvenile shrimp, with complete regeneration of abnormal growth within two weeks. By contrast, both cutting methods can be applied with sub-adults but regeneration time is quite long (at least 2 months). Nonetheless, tail-cutting is recommended as a good tagging method for shrimp and probably other crustaceans, as they retain the tags even after molting.

Table 1 Regeneration and tag retention rates (%) in *Litopenaeus vannamei* after four months of culture.

Treatment	Regeneration Rate	HT	FT	N	AG	IG	Tag retention
Juveniles							
Control	0.0	-	-	-	-	-	-
Half-cut	100.0	77.8	13.3	8.9			87.5
Whole-cut	100.0			100.0			-
Sub-adult							
Control	0.0	-	-	-	-	-	-
Half-cut	100.0	68.8	18.8	12.5			100.0
Whole-cut	100.0			5.2	68.5	26.3	100.0

MIGRATION PATTERN AND POPULATION DYNAMICS OF *Channa striata* IN THE RAINFED RICE FARMING LANDSCAPE OF NORTHEAST THAILAND

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The snakehead *Channa striata* is a common fish species associated with rainfed rice farming landscapes and other wetlands areas in Southeast Asia. Highly appreciated for its taste and a valuable commodity, snakehead is intensively exploited. In spite of their recognized importance, little is known about the ecology and population dynamics of the species in rice farming landscapes. A tagging experiment was conducted in two villages in northeast Thailand to establish migration, mortality and growth patterns. A total of 751 tagged fish were released during three distinct events in the late dry season, and in the beginning and at the end of the rainy season. About 20% of tagged fish were recovered within one year of catch monitoring, 60 % of these within 2 months of release. The majority of fish were recaptured within 500m of their release site, but some moved for distances up to 3 kms. Natural and fishing mortality rates were estimated by fitting a simple population model to tag-recapture data. Preliminary estimates of natural mortality $M=5.4\ y^{-1}$ and fishing mortality $F=2.3\ y^{-1}$ suggest that *C.striata* in rice farming landscapes are subject to extremely high rates of mortality overall. Fishing mortality, albeit high, is only moderate when compared to natural mortality. Implications of these results for the management of snakehead fisheries in rice farming landscapes are discussed.

POPULATION DYNAMICS *Penaeus semisulcatus* IN IRANIAN WATERS OF PERSIAN GULF

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Shrimp is one of the most important aquatic resources in the Persian Gulf. More than 15 shrimp species have been identified in the Persian Gulf and the Sea of Oman; 12 species are found in Iranian waters. Green tiger prawn, *Penaeus semisulcatus*, is an important species comprising 90% of the shrimp catch in the coastal waters of Iran. Research carried out during 2001-2002 showed that the catch of green tiger prawn has declined to 1110 tonnes. Two populations are distributed in the Persian Gulf. Different water temperatures in the different areas of Persian Gulf, and two populations of shrimp, result in two spawning seasons for this species in Iran, namely the end of autumn and early spring. The growth parameters of *Penaeus semisulcatus* were estimated from length-frequency samples. They are $L_{infinity}$ =20.5 cm, k=0.91 $year^{-1}$. Research is underway to identify the mean length at recruitment, Lr, the mean length at first capture, Lc, and the mean length at sexual maturity, Lm. Mean length of female shrimp during the spawning period is 15.7 cm. Recruitment to the adult stock often takes place at particular times of the year when juveniles have reached a certain size. Recruitment time is July and Lr =8 cm and L_c=12 cm.

FISH CATCH ASSESSMENT OF FLOODPLAIN FISHERIES IN BANGLADESH: A CASE STUDY OF MALJHEE-KANGSA FLOODPLAIN

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A monthly field survey was conducted to examine types of fishing gear, fishing effort, duration of fishing and their catches in the Baila beel of Maljhee-Kangsa floodplain in the north-central part of Bangladesh from January 2003 to December 2003. A total of 7 types of fishing gear were recorded being used by the fishermen. Variations in the catch per unit of effort (CPUE) of different gears in different seasons were observed. The highest and the lowest CPUE were recorded in monofilament gill net and hook and line which were 0.31 and 0.02 kg/gear/hour respectively. According to the fishermen, the highest catch was obtained during the receding of floodwater in the post-monsoon season (October-December) and the lowest during the pre-monsoon season (April-June). A total of 39 fish species were identified in the catches of different gears. From the survey it was found that a fisherman daily catches on an average 1.43 kg of fish. Alarmingly, the catch of fish has declined by an estimated 20% in the past five years. Recommendations are made for sustainable catches through fisheries enhancement by stocking, habitat restoration and construction of fish sanctuaries as well as community participation.

Table 1 Average fishing effort, fishing hours and catch per unit of effort (CPUE) of different gears in the Baila *beel* of Maljhee-Kangsa floodplain.

Name of gear	Fishing effort (number of gear/day)	Duration of fishing (hour/day)	CPUE (kg/gear/hour)
1. Push net	6.67	3.21	0.18
2. Gill net	3.17	4.75	0.26
3. Cast net	8.33	3.78	0.21
4. Lift net	5.25	4.71	0.29
5. Monolfilament gill net	3.75	7.26	0.31
6. Fish trap	48.17	13.47	0.06
7. Hook	67.0	11.87	0.02

CULTURE-BASED FISHERIES IN NON-PERENNIAL RESERVOIRS OF SRI LANKA

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Small non-perennial reservoirs are scattered in the dry zone of Sri Lanka irrigating about 175,000 ha of agricultural land and benefiting about 700,000 families in rural areas. These small reservoirs can be utilized for the development of culture-based fisheries. For this purpose, reservoirs should be stocked with fish fingerlings once they get filled with rainwater during the inter-monsoonal period of December-January and harvested during dry season in August-October.

Present study was conducted in five administrative districts of Sri Lanka namely Anuradhapura, Kurunegala, Hambantota, Monaragala and Ratnapura. Thirty two reservoirs were stocked with *Aristicthys nobilis, Cyprnius carpio, Labeo rohita, Catla catla, Cirrhinus mrigala, Macrobrachium rosenbergii* and GIFT strain of *Oreochromis niloticus.* Due to poaching and false reporting, reliable data on fish yield could be obtained from only 23 reservoirs (10 from Anuradhapura and Kurunegala districts and 13 from Hambantota, Moneragala and Ratnapura districts). Standard length and body weight of fish were measured at stocking and harvesting. Number of fish in each species and weight of individual species harvested were also recorded.

Fish yield ranged 53.3 -1800.8 kg ha^{-1} with a mean value of 449.8 kg ha^{-1}. The mean yield from non-perennial reservoirs in the southern region is higher than that in Anuradhapura and Kurunegala districts, where considerable proportion (8.7%-38.3%) of *Channa striata* was present in the harvest (Fig. 1). Fish yield is significantly related to reservoir area (negative curvilinear), stocking density (negative second order) and chlorophyll-a (positive second order) at 5% probability level. *A. nobilis* yield seems to have a significant positive impact on the total harvest ($p<0.05$). Although not significant ($p>0.05$), increase of the proportion of *C. striata* in the yield seems to have a negative impact on overall fish yield. Results show that *A. nobilis, C. carpio* and *L. rohita* are suitable for polyculture in non-perennial reservoirs. GIFT strain of *O. niloticus* stocked with carp species, gave low specific growth rate. *M. rosenbergii* harvest was poor and represented in yields of two reservoirs.

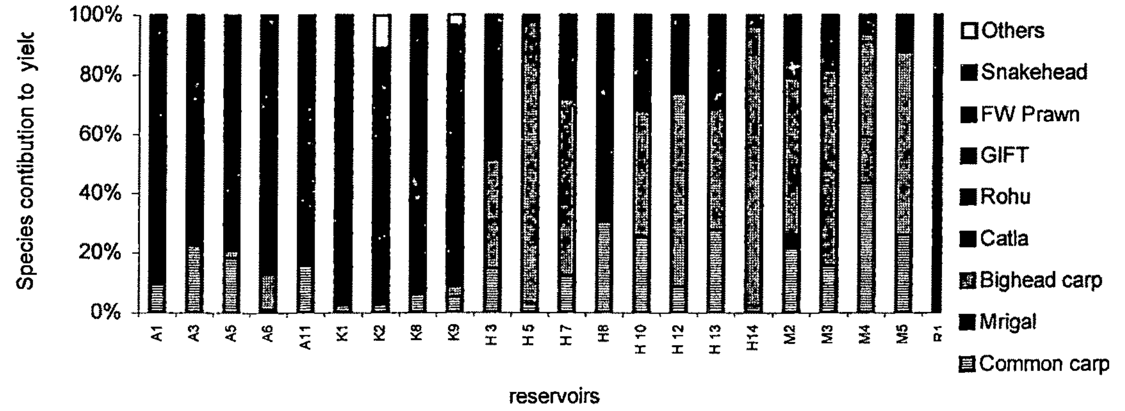

Fig 1 Percentage yield of species in the harvests in non-perennial reservoirs of Sri Lanka

THE EFFECT OF THE COMMERCIAL FISHING CLOSURE ON ABUNDANCE OF JUVENILE FISH STOCKS AT TOWRA POINT, BOTANY BAY, NSW, AUSTRALIA

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In May 2002, Botany Bay, eastern Australia, was closed to commercial fishing with the aim of increasing the availability of fish for recreational fishers. It was hypothesized that the effect of the closure would be most immediately obvious in the numbers of juveniles of commercially important fish, particularly in the habitats where they congregate; the seagrass, mangrove and saltmarsh wetlands of the bay. A pre-closure study on fish abundance at Towra Point, and at two reference sites, between March 2001 and February 2002 showed that juveniles of commercially important species were frequently visiting saltmarsh, mangrove and seagrass habitats during spring high tides. In this study, we repeated the survey two years after the fishing closure using the same methods in the same locations. We report on changes in the assemblages of small fish visiting wetlands following the fishing closure, including the likely effect of increases in abundance of commercial species on non-commercial species. The results provide some insight into the effectiveness of fishing closures, and the trophic interactions between commercial species and smaller, non-commercial species.

AGE AND SIZE COMPOSITIONS OF SOUTHERN BLUEFIN TUNA *Thunnus maccoyii* CAUGHT BY TAIWAN LONGLINE FISHERY IN THE INDIAN OCEAN

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Taiwan started to train vessel observers to collect the otoliths of Southern Bluefin Tuna (SBT, *Thunnus maccoyii*) otolith in the Indian Ocean since 2002. A total of 102 SBT otoliths were successfully collected on the SBT longline vessel in 2003. The otoliths collected were randomly selected according to the length frequency distribution of the total catch of the SBT which were caught around 30 – 32 °S and 67 – 89 °E in the Indian Ocean. The length of the SBT ranged from 92 cm to 177 cm with an average of 129.2 ± 21.6 cm and weighted from 12 to 76 kg (average 34.3 ± 17.0 kg), respectively.

The ages of the SBT were estimated to be from 2 to 15 year old with mean age of 5.2 ± 3.1. The age composition of the 102 SBT can represent that of the total catch of Taiwan longline fishery because the size composition was similar between these 102 aged SBT and total catch. Meanwhile, the age composition of the catch was estimated by the von Bertalanffy growth curve $t = t_0 - \frac{1}{k}\ln(1 - \frac{L_t}{L_\infty})$, where t_0 = -2.85, k = 0.14, and L = 187.77. The SBT, ages distribution at 2 to 9 year old were accounted for about 90% of the total catch of Taiwan longline fishery. The life span of SBT is approximately 40 yrs old. This indicated that the population of SBTs caught by Taiwan longline fishery in the Indian Ocean were younger ones.

DIRECTED FISHERIES FOR DOLPHINS AND DUGONG IN SABAH, EAST MALAYSIA: PAST AND PRESENT

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Interview survey procedures were used to determine the magnitude of directed fisheries for cetaceans and dugong, and estimate level of mortality in East Malaysia. Between March 1997 and April 2004, a total of 1,034 fishermen/villagers were interviewed along the coast of Sabah. Most respondents are artisanal fishermen, employing gillnets and traditional gears (lift nets, hooks and lines, and traps) using small non-motorised/outboard-engine boats. They were asked questions pertaining to their fishing effort, cetaceans and dugong hunting activities and uses of the catches.

About 28% (294) of the total fishermen/villagers interviewed responded positively to having hunted the animals or reported their fathers/ancestors hunting activities in the past. A majority (78%) caught dugongs, 17% caught dugongs and dolphins, while only a small number (5%) targeted dolphins. Compared to the number of respondents in each region, the Eastern and Northeastern regions recorded higher percentages (35 and 30%, respectively) of hunting cases than in the Western region (22%). The majority of the respondents (68%) and hunters (69%) are *Bajau* descendants and their methods of capturing the animals are described. Dolphin species so far known to be involved are the bottlenose dolphin, *Tursiops sp.*; spinner dolphin, *Stenella longirostris* and pantropical spotted dolphin, *Stenella attenuata*.

An average of 5.2 ± 1.16 (95% CL) dolphins and 2.8 ± 0.37 (95% CL) dugongs were caught per hunter annually. In all regions, the animals were reported to have been caught using hand harpoons/spears (50-75%), dynamite (3-21%), fishing nets (0-8%) or a combination of hand harpoons/spears-dynamite (18-33%). Although both animals were hunted in the whole year, dolphins were caught mostly during daytime while dugongs were caught exclusively at night, especially during new moon period. Animals caught were consumed by family members (100%), shared among neighbours (50-86%), traded (15-43%) and used as fishing baits (22-52%). Many hunters (50-75%) believe that the meat and parts of the animals have medicinal values and 10-32% of them reported ceremonies or rituals associated with the hunting. A majority (84%) of dugong hunters claimed to have sought the help of indigenous medicine men (locally known as *pawang*) to locate and catch the animals.

About 70 and 91% of the 63 dolphin and 280 dugong hunters, respectively, admitted that the number of animals has dropped significantly in the past few decades. Most of them (89%) had stopped hunting in the 1980's. Currently, there are probably less than 11% of hunters left that still catch the animals, at least occasionally, or opportunistically during fishing trips. Also in the surveys, about 81% of the total 1,034 fishermen/villagers interviewed knew or had been informed by the authorities that hunting, trading, and possessing cetaceans or dugongs are illegal in Malaysia. Therefore, dedicated efforts to educate the traditional fishing communities and enforce wildlife/fisheries protection laws need to be given high priority aimed at eventually ending the hunting activities. If not, dolphins and dugong populations in East Malaysia will continue to face this anthropogenic threat that will continue to push the populations to the brink of local extinction.

TAXONOMY AS A BOTTLENECK IN FISHERIES MANAGEMENT: A CASE STUDY FROM CAMBODIA

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This paper results from a study initially aimed at identifying the ten dominant species in Cambodian commercial fisheries, for management purposes (focused monitoring and biological studies). It is based on an analysis of dominant species in available commercial fisheries statistics, in which data were collected using Khmer names. However the equivalence between Khmer fish names and Latin species names is not straightforward, as one Khmer name can correspond to several species. In this study the dominant taxa in each of the three main Cambodian fisheries were identified, and the contribution of each fishery to the total catch allowed the identification of the ten dominant taxa overall. Then Rainboth (1996), FishBase 2004 and the MRC Mekong Fish Database were used as references to convert Khmer fish names into Latin species names.

Thus the 10 taxa in the total catch of commercial fisheries, as identified by their Khmer name, actually correspond to about 45 scientific species (taking into account a few uncertainties given taxonomic disputes). Subsequently:

1) top ten commercial fish *species* caught in Cambodia are, stricto sensu, still unknown to science;
2) the equivalence tables used so far to convert Khmer names into scientific species names were univocal and inexact;
3) socio-economic statistics detailing species and based on these previous conversion tables are inexact (they might be accurate as long as the fish name is expressed in Khmer, but not when it becomes converted into a Latin scientific name).

Insufficient taxonomic knowledge has an impact on the proper identification of species to be managed, on the link between scientific knowledge about species (identified in Latin) and management priorities based on statistics in which fishes are identified in Khmer, and also on the economic figures that drive global management decisions.

SATELLITE BASED FISHERY FORECASTING FOR THE BENEFIT OF COASTAL FISHERFOLK

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Intensive validation programmes of Potential Fishing Zone (PFZ) Advisories generated by the Indian National Centre for Ocean Information Services (INCOIS), Hyderabad under the Department of Ocean Development, Government of India at selected marine fish landing centers along Kerala coast revealed positive relationship between PFZ and occurrence/abundance of commercially important pelagic fishes. An attempt has been made to identify possible reasons for the above based on results of oceanographic and marine biological investigations undertaken in the area and also taking into consideration the behaviour of selected species of pelagic fish in relation to environment and also food and feeding habits. The usefulness of PFZ advisories for the artisanal and small mechanized/motorized sector fishermen towards reducing the search time for shoaling fishes thereby effecting an overall reduction in the cost of fishing operations and also towards achieving a higher Catch Per Unit Effort is highlighted.

POPULATION PARAMETERS OF OYSTER *Crassostrea madrasensis* OF BANGLADESH COAST

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FiSAT software was used to estimate the population parameters of *Crassostrea mandrasensis* from length-frequency data collected from St Martin Island of Bangladesh. The asymptotic length (L_∞) and K were estimated at 14.79cm and 0.40/year. The annual rates of natural, fishing and total mortality were 1.20, 0.31 and 1.51 respectively. The rate of exploitation (E) was estimated as 0.21. Maximum allowable limit of exploitation (E_{max}) was found to be 0.40. The mean length at first capture (Lc) was estimated as 2.07 cm. The oyster is recruited to the fishery throughout the year but peak recruitment takes place during the month of April.

MULTIVARIATE APPROACH: STATUS OF SMALL PELAGICS IN THE EAST COAST OF MALAYSIA (1976-98)

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In Malaysia, the marine capture fisheries in the east coast of Malaysia have been contributing at least 40% of the catches in the whole country during the last two decades. Among the fisheries resources in the area, small pelagics are considered as very important fish resources. Catch fluctuation of small pelagic is caused by various factors which may be difficult to determine. However, catch trends can be considered as an important baseline data that describe harvest of major species in a particular year.

This study analyzed the status of major species based on annual catch data. Seventeen small pelagic species obtained by purse seining were selected and their catch was analyzed by correlation analysis and principal component analysis. The correlation analysis showed the relationship among other sub-areas in the South China Sea on the basis of catch composition by year. The catch composition of East coast of Malaysia showed significant relations with North Java at 91% (Significant in 21 years during the total of 23 years from 1976 to 1998). The principal component analysis indicated that alteration of major catches were observed eleven years intervals while there were no catches for some species groups after certain periods.

BRUSH AND VEGETATION PARK FISHERY IN THE FLOODPLAIN RIVER TITAS, BRAHMANBARIA, BANGLADESH

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A study was conducted in the River Titas in Bangladesh from November 2001 to June 2002 on fish aggregation device (FDA), locally known as katha (brushpiles) an important means of fishing in this river. A total of 76 katha was surveyed and weekly catch data was collected. The size of katha ranged from 0.12 to 1.17 ha with an average size of 0.35 ha. The total production from katha was estimated at 750 kg/ha/year. In the catch, more than 47% fish were Siluriformes (catfish) including *Wallogo attu, Mystus cavasius, M. gulio and M. vittatus* followed by Perciformes 18.5% (*Chanda nama, C. baculis* and *Anabas testudineus*) and Cypriniformes 3.2% (*Puntius sophore, P. sarana, Labeo rohita* and *L. gonia*). Small and large prawns contributed more than 16% of total production. Livelihood assessment of fishermen indicated that 15% middle class, 32% poor and 53% were landless. The production indicated that the River is in an over exploitation state and need immediate measures to conserve the resources. The poor and landless fishermen living adjacent to this area have no other alternatives except fishing during dry season. For proper management of fishery and to conserve biodiversity in the River Titas community based fisheries management approach is needed.

PARTNERSHIPS, COLLABORATION AND COOPERATION FOR EFFECTIVE MARINE RESOURCES MANAGEMENT: THE FIJI LOCALLY MANAGED MARINE AREAS (FLMMA) NETWORK

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Over the last two years, the Fiji Locally Managed Marine Areas (FLMMA) network, in promoting locally managed marine areas in Fiji, has demonstrated a great deal about partnerships, collaboration and cooperation that provide useful lessons that need to be taken into consideration. The FLMMA network consists of a number of organisations in Fiji that are working with local communities in the management of their marine resources. The network is based on the principle that people want to make marine resources management more effective and beneficial to local communities and contribute to the improvement of the living conditions of the people involved. FLMMA members are committed to work together and to share their experiences because the sum of their collective effort is far greater than the sum of their individual contribution.

Guided by a social contract that emphasises respect for each other, trust and good conservation practices, FLMMA has fostered working relations with the local government departments, international donor organisations, international and national organisations and the local communities.

The partnership, collaboration, and cooperation are resulting in good conservation practices and the commitment of local communities to self determined development. This is why at the recently concluded World Summit on Sustainable Development; FLMMA was declared one of the six winners of the United Nations Development Programme's Equator Initiative for outstanding contribution to poverty alleviation and conservation. The network is committed to effective conservation while upholding the integrity of local communities to self-determined developments that improve their lives.

PRAWN LANDINGS AND THEIR RELATIONSHIP WITH THE EXTENT OF MANGROVES AND SHALLOW WATERS IN WESTERN PENINSULAR MALAYSIA

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This study investigated changes in landings of all prawns, white prawns (mainly *P. merguiensis*), mangrove extent, rainfall and the area of shallow water in western peninsular Malaysia. The most important state for both the landings of all prawns and white prawns was Perak, where about 50% of all prawns and 35% of white prawns were landed. This is also the state with the largest, and most stable, extent of mangrove forest reserve (40,000 ha) and the largest area of shallow water (< 5 m deep). Juvenile prawns from Perak may contribute to the landings of the adjacent states of Penang and Selangor, where the second highest landings for white prawns and total prawns, respectively, were found. The area of shallow water accounted for the greatest proportion of variation in landings of both all prawns and white prawns, and was the most significant variable fitted to multiple regressions of landings and coastal attributes (area of shallow water, mangrove area, length of coastline). Although there was a significant linear relationship between the landings of total prawns and mangrove area in both the 1980s and 1990s, this was not the case for the mangrove-dependent white prawns where a significant relationship was found only for the 1990s. Furthermore, landings of all prawns and white prawns in Selangor and Johor, where large losses of mangrove forest reserves have been recorded, appear to have been maintained or increased in the 1990s. The lack of a clear relationship between mangrove loss and prawn landings may be due to the migration of prawns from adjacent areas or that attributes of mangroves, such as the length of mangrove-water interface, may be more important for the growth and survival of prawn populations than total area of mangroves.

SIDE SCAN SONAR IMAGES OF ARTIFICIAL REEFS

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Artificial reefs around Korean waters were surveyed and scanned by a side scan sonar to investigate state of burial. The WideScan 3050 model sonar scans seafloor with high resolution dual frequency (100/325 kHz). Raw data were processed and digitally enhanced by Coda DA 50. Seafloor sediment samples around the reefs were collected using piston or gravity cores. Standard grain size analysis method using pippet and/or sedigraph (Micromeritics 5100) was employed for sediment texture. Helium pycnotmeter and motorized shear vane were also used to determine porosity, density and vane shear strength of sediments. Some of the reefs were buried more or less partly or almost completely. Variables that affect reef burial are activity of bottom currents, shape of reefs, and types of sediment. Among them sediment texture particularly for the amount of clay, is very important factor which determine the behavior of reef burial. Mean grain size of sediment is also important. Other physical properties of sediments such as vane shear strength, porosity and bulk density are also valuable parameters for the burial. It is highly recommended that periodic marine geophysical and geological survey including high resolution sub-bottom profiling as well as side scan sonar to monitor the reefs. We also suggest pre-site survey that including geological factors to find the optimum location to minimize reef burial.

IMMEDIATE IMPACT OF BOTTOM TRAWLING ON MACROBENTHOS WITH SPECIAL REFERENCE TO POLYCHAETES IN THE INSHORE WATERS OF SOUTHWEST COAST OF INDIA

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The immediate effect of bottom trawling on macrobenthos was studied during December 2000 to November 2002 along Cochin – Munambam area (Long.76°10' 94" to75° 56'00" and Lat. $9^0$58' to $10^0$10'), in the southwest coast of India at depth ranging form 0-50m. Trawling operations were carried out at five depth zones viz. 0-10, 11-20, 21-30, 31-40 and 41-50m with two stations at each depth zone, using a commercial trawler of size 45 OAL. The immediate effect of bottom trawling on the macrobenthos was studied by comparing the abundance (no.m^{-2}) and biomass (g.m^{-2}) of the macrobenthos obtained from the sediment samples collected before and after experimental trawling conducted at the study area. Among the various macrobenthos collected, polychaetes emerged as the numerically dominant taxa, in almost all seasons and depths. The polychaetes were represented by 80 genera in which the most commonly occurring were *Ancistrosyllis, Cossura, Prinospio, Sternaspis, Lumbrineries, Magelona, Nepthys* and *Glycera*. Polychaetes showed a preference for sandy area (> 40m depth) and exhibited high abundance in this zone, while silty and clayey regions (0-40 m) harbored the lowest abundance. The results of the study clearly demonstrate that the bottom trawling caused heavy variations on the abundance, biomass and diversity of the infaunal macrobenthic populations. In the samples collected after trawling, wide variations were noticed in the abundance and biomass of polychaetes in the samples collected after trawling when compared to that of before trawling. However the variations were found statistically insignificant ($P > 0.01$). Highest abundance of polychaetes were recorded at the station 9 in May 2002 where polychaetes abundance increased to 20,710 no.m^{-2} after trawling from 2,787 no.m^{-2} recorded in the samples collected before trawling. In the case of biomass, the highest variation was observed at station 3 in December 2000 where biomass increased to 34.53 g.m^{-2} in the samples collected after trawling from 7.16 recorded before trawling. Multivariate community analysis carried out based on both species abundance and biomass of polychaetes also confirm the wide variations in the similarities of the stations comparing both before and after trawling. Diversity indices also showed the increase in the diversity of polychaetes in the samples collected after trawling in the majority of stations than that of before trawling. Shannon diversity ranged between 1.00 and 1.67 after trawling when compared to 0.46 and 0.65 before trawling. After trawling, species richness also increased to 0.70-1.38 as compared to 0.71- 1.19 before trawling. The role of fishing holidays on the recoupement and regeneration of infaunal macrobenthos is also discussed.

IMPACT OF STOCKING ON YIELD AND BIODIVERSITY OF NON-STOCKED INDIGENOUS FISH SPECIES IN OXBOW LAKES WITH SPECIAL REFERENCE TO ENVIRONMENT AND LIVELIHOOD

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Fish culture in oxbow lakes, semi-closed water bodies locally known as *Baors*, is practiced by converting an open water fisheries by screening the inlets and outlets into a culture-based fisheries. Three species of Indian major carps (*Labeo rohita, C. catla* and *Cirrhinus mrigala,*) and three Chinese carps (*Hypophthalmichthys molitrix, Ctenopharyngodon idella* and *Cyprinus carpio*) are regularly stocked and harvested. Different stocking and harvesting regimes are practiced in these oxbow lakes. Various management measures such as high, moderate and low stocking, multiple, continuous and single stocking, and continuous and periodic harvesting, are practised. A study on the impact of level and periodicity of carp stocking on yield and species diversity of non-stocked indigenous fish species (NIFS) was carried out in nine selected oxbow lakes located in four districts in southwest Bangladesh: Jessore, Jhenaidah, Chuadanga and Kushtia. Records of fish stocking and harvesting of stocked fish from all nine lakes were collected from respective Lake Fishing Team (LFT), an organized fishers' group responsible for management of each lake, while fishers' catch were regularly sampled to monitor the yield and species composition (number and weight) of non-stocked indigenous fish species.

Two types of fishing gears are used almost exclusively to catch stocked carp: purse seine nets *(kochals)* and brush parks *(komars)*, while a variety of fishing gears (nets, traps and wounding gears) were operated for fishing of non-stocked indigenous fish. Except that for Kaliganga Lake in Kushtia, the single dominant species was Indian River shad (*Gudusia chapa)* accounting 10.75 to 72.37% of total NIFS catch. The other dominant species harvested by different gears were giant river catfish (*Aorichthys seenghala*), a variety of prawn species (*Macrobrachium* sp.), tank goby (*Glossogobius giuris*), glassy perchlet (*Parambassis* spp.), barb (*Puntius* spp.), snakehead (*Channa* spp.), catfish (*Mystus* spp.), freshwater eel (Mastacembelus spp. and *Macrognathus* spp.), mola carplet (*Amblypharyngodon mola*) and Gangetic leaffish (*Nandus nandus*).

Although the trend is not very conclusive, the results of the study indicate that high density (≥5000 nos./ha) multiple stocking and continuous harvesting in some of the lakes has apparently led to the reduction of yield and biodiversity of non-stocked indigenous fish. For example, in some of the lakes where high stocking densities (≥5000 nos./ha) have been used over the last 7 years, the number of NIFS recorded during the study period were between 18 and 23, while in lakes where the average stocking densities were ≤2000 nos./ha, species diversity varied between 38 and 43. The study further showed that subsistence fishing of NIFS has a significant impact on livelihood of fishers and people living around the lakes. In some of the lakes, over 50% of the fishers were engaged in fishing NIFS and were completely dependent on these fish for their livelihood. It was also observed that intensively managed (with high density stocking) culture-based fisheries in oxbow lakes led to the restriction of community access for subsistence fishing. In the light of above findings, recommendations for rational management of oxbow lakes and similar water bodies within the broader framework of aquatic resource management are made.

SEASONAL ABUNDANCE OF BENTHIC COMMUNITIES IN CORAL AREAS OF PULAU KARAH, TERENGGANU, MALAYSIA

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Studies have been done in Pulau Karah, Terengganu to find the relationship between benthic communities during different seasons and in different types of substrates. Surveys were conducted four times; two times during non-monsoon phase (May – June) and two times during monsoon phase (September-October). Samples of benthic fauna in coral and non-coral areas were taken using hand corer and Smith McIntyre grab respectively. In-situ measurements have been done to obtain physico-chemical parameters including salinity, temperature, pH, and dissolved oxygen. All samples collected were identified up to family levels. Both macrobenthos and meiobenthos were found to be more dominant during pre-monsoon season as compared to monsoon season. In terms of family, Polychaeta were the most abundant during both monsoon and pre-monsoon seasons. Benthic fauna were found in higher numbers in coral area and they were found to be decreasing with distance from shoreline. Polychaeta were found to be the most dominant family in both coral and non-coral areas.

UNDERSTANDING FISH FIGHTS OVER FISH RIGHTS: CONFLICTS AND OVERCAPACITY IN FISHERIES IN SOUTHEAST ASIA

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The study examined the prevailing conflicts in developing countries such as Cambodia, the Philippines and Thailand where fisheries is the government's source of income from export revenues, livelihood base for fishers and source of food for the poor in "open access" coastal and inland water bodies. One of the key conflicts is among different gear operators and between large- and small-scale fishers (Table 1). The multiple "uses" and the lack of, if not total absence, of workable regulations put pressure on the fisheries. When there is overcapacity in the fisheries a choice has to be taken between those who can fish and those who cannot. This involves the dilemma of allocating participation among industrial and artisanal fishing sectors, gear types and areas. This project looks into the processes by which exit strategies could be formulated where some levels of efficiency may have to be sacrificed for equity. The process begins with the characterization of the conflicts on the biological, social and economic context. The three case studies represent different resource conditions, institutions, conflict situations and potential security issues at the national and regional levels.

Table 1 Prevailing fisheries conflicts in Cambodia, the Philippines and Thailand.

*Typology of Conflicts**	**Cambodia**	**Philippines**	**Thailand**
TYPE I Who controls the fishery	Conflicts arising from access rights of fishers (large-fishing lot operation, medium, community fisheries)	Conflicts of rights and ownership between the concessionaires and fishermen	Conflicts of rights between fishermen
Type II How are the fisheries controlled	Over- enforcement by lot owners utilizing military force	Concessionaires has control over the resources by under pricing fish caught by fishermen	
Type III Relations between the fishery users	Rivalry between ethic groups	Rivalry between artisanal and commercial fishermen	Rivalry between the small scale and large-scale fishers such as the anchovy's fishermen
Type IV Relations between fishers and other users of the aquatic environment	Conflicts between the farmers and fishers (use and access to water and land resources-forest)	Conflicts over aquatic resources between the fishery and sectors such as tourism, navigation/ docking, sand quarrying and mariculture	Conflicts between rice farmers and prawn breeders
Type V Relationship between fishers and no–fishery issues	Lack of proper management and enforcement by government authorities due to weak institutional structure	Lack of proper management and enforcement by government authorities due to weak institutional structure	Lack of proper management and enforcement by government authorities

* Based on Bennett E. et al. (2001) Towards a better understanding of conflict management in tropical fisheries: evidences from Ghana, Bangladesh and the Caribbean, *Marine Policy*, 25:365-376.

EFFECT OF FISH STOCKING SIZE, DENSITY AND FERTILIZER ON WATER QUALITY IN RICE FIELDS FOR PRODUCTIVITY ENHANCEMENT IN INTEGRATED RICE-FISH FARMING IN HILLS OF NEPAL

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Rice-fish farming as an ecological farming practice started around 1960 but could not be adopted well in Nepal until 2000. Reasons for low adoption is low production and productivity from rice-fish culture due to non-judicious stocking of fish and agronomic practices for rice and fish that differ under varying ecological conditions. Participatory studies were carried out to evaluate fish stocking density and effect of fertilizer on water quality and rice field productivity in rice growing areas of river basin and low hills.

To evaluate rice and fish yield with 3 stocking densities (4000, 5000 and 6000 nos/ha) of common carp (*Cyprinus carpio)* in combination with 2 sizes of fingerlings (5-10 g and 10-20 g) and Sabitri rice, rice-fish integration studies were undertaken with farmer's participation. Gross fish yield of 143.4 kg/ha and 477.8 kg/ha were obtained at 4000/ha and 6000/ha density, respectively; with initial stocking size of 15-20 g was significantly higher ($P<0.05$) than other treatments employed in the experiment. Net fish yield was higher in treatments of 6000/ha stocking density with 5-10 g size fingerlings (304.4 kg/ha) and 6000/ha density with 15-20 g size fingerlings (337.0 kg/ha). Rice yield was not significantly different ($P>0.05$) among all treatments including treatment without fish. This study demonstrated that production of rice does not decrease by integrating fish with rice farming.

The effect of fertilization practices on physico-chemical properties of water in rice-field is largely undocumented. Water quality parameters affecting fertility and productivity of rice-fish farming were studied for dry season rice in low hill area during March to July 2000. Water temperature (26.8±5.5 ^{0}c), dissolved oxygen (7.2±2.9 mg/L) and pH (7.4±1.0) observed in dry season rice-fish fields with inorganic fertilizer were not significantly different ($P>0.05$) to that of rice-fish fields with organic fertilizer. Nitrite+nitrate-N (0.064±0.04 to 0.071±0.03 mg/L) and phosphate phosphorous (0.096±0.06 to 0.14±0.047 mg/L) were rather low, in spite of frequent fertilization at 7 tons/ha organic manure and 100-30-30 kg/ha NPK, respectively, in rice fields treated with organic and inorganic fertilizers. Mean value of chlorophyll concentration (42.1 µg/L) was significantly higher ($P<0.01$) in rice-fish field with inorganic fertilizer than the rest of the treatments.

The mean fish yield was 364±77.2 kg/ha and 294±60.4 kg/ha, respectively, for organic and inorganic fertilizer treatments. Low water level, declining water pH and temperature at later stage of rice growing period did affect ($P<0.05$) the growth and survivability of fish in rice field. Although not significant, rice yield increased by 11.8% in rice-fish fields over rice monoculture. Presence of fish through its role on biopurturbation and grazing on photosynthetic aquatic organisms could have played greater role to influence rice yield.

THE ANGELWINGS (FAMILY PHOLADIDAE) OF THE PHILIPPINES: STATUS AND PROSPECTS FOR DEVELOPMENT

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The angelwing, *Pholas orientalis* (Gmelin) locally called "*diwal*" is one of the three bivalve species belonging to the Family Pholadidae that are commercially exploited in the Philippines. The other two species are *Barnea dilatata* and *B. manilensis*. *P. orientalis* is sweet, juicy and has a tender taste making it as one of the highly sought shell food in Central Philippines. However, its rapid depletion and disappearance in their traditional grounds has deprived many coastal fishermen of a good source of livelihood. Thus, there is a growing concern now among fishermen, local and national government officials, scientists and researchers to rehabilitate these grounds and improve the *P. orientalis* industry.

Successful stock enhancement programs either through transplantation and/or seeding could result in a sustainable production of *P. orientalis* in the country. Prerequisite toward this, is a successful hatchery operation. This paper presents recent research initiatives by the University of the Philippines in the Visayas on the angelwings. The paper provides information on: (1) description of the history of the *P. orientalis* industry, its problems and constraints, and (2) research results on the (a) habitat and reproductive biology, (b) broodstock maintenance and early gonadal maturation, and (c) induced spawning and early larval development of *P. orientalis*. Future research needs are identified and the recommendations for a better management schemes are presented.

IMPROVEMENT OF FISHERY RESOURCES IN CHILIKA LAGOON AFTER OPENING OF THE NEW MOUTH

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Chilika is the largest brackish water lagoon in Indian sub-continent supporting unique ecological features with freshwater, brackishwater and marine endemic species of fish, prawn and crab which enrich the fishery resources of the lagoon. It supports food and livelihood security to more than 0.2 million fishermen living in its periphery. Due to the continued environmental degradation, anthropogenic pressure and increase in fishermen population, the lagoon lost its pristine glory of having rich fishery resources. Collective impact of several inherent and external factors encountered by the lagoon causes decrease in fish, prawn and crab landing during the last decades.

The fish and prawn production of the lagoon consistently decreased from 1988-89 onwards to a lowest production of 1260.0 MT during 1995-96, which was 85.7% less than the highest production of 8872.0 MT during 1986-87. Similarly, the crab landing was dropped from 79.0 MT during 1985-86 to 3.0 MT in 1994-95. This declining trend in the landings was primarily associated with siltation of channels, chocking of inlet channel, shifting of mouth connecting the sea, decrease in salinity gradients, excessive growth of fresh water weed in northern sector, etc. All the above factors resulted decrease in fish productivity and over all loss of biodiversity. To address these problems, Chilika Development Authority (CDA) has taken up restoration measures like dredging of lead channel, opening of new mouth, excavation of river outfall points etc. using grants provided by Government of India. After the most successful historical intervention, a spectacular change has been observed in the fishery resource of Chilika lagoon. The fish, prawn and crab landings of the lagoon have increased to 10,286.34 MT, 3611.37 MT and 155.51 MT respectively during 2003-04. Comparative account of fish, prawn and crab landing of pre and post dredging period and the related environmental factors that induced the significant growth of fishery resources of the lagoon is discussed in the paper.

SOME CONSIDERATIONS ON THE POPULATION DYNAMICS OF *Thunnus albacares* IN THE OMAN SEA

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The yellowfin tuna is caught more than any other species in the southern waters of Iran (24000 tons per year). To identify sustainable catch levels, there is a need to determine the key biological characteristics and population dynamic parameters of this species. This paper is the first study to do this for yellowfin tuna distribution in the Oman Sea.

Data from 1999-2000 from different fishing grounds in the Oman Sea were pooled. Based on the length and weight of more than 2000 specimens in the size range 38-173 cm, the length-weight relationship was calculated as W=0.000012 L^ 3.0831. Length infinity was estimated as 189 cm with a growth parameter of 0.42 per year. Growth performance index was 4.18, which is in agreement with the findings of other studies in the Indian and Pacific Oceans. The mortality and exploitation rates were estimated as:

$Z = 1.75 - 1.85$ $M = 0.6$ $F = 1.25$ $E = 0.68$

Occurrence of empty stomachs in the specimens examined was high (60%). Purpleback flying squid (*Symplectoteuthis oualaniensis*) was the most dominant prey species, occurring in 57% of females and 60% of males. Teleost fishes were the second most common food items (42% occurrence in females and 38% in males). Crabs also were also present at low frequency (1-2%). Males were predominant at all sizes above 120 cm fork length. The sex ratio was 52.53 % males and 47.47 % females. The monthly gonadosomatic index was higher during January-June. The general trend of the index suggested that the spawning period can be extended, from January to June, according to optimum sea surface temperature.

COMPUTERIZED FISHING GEAR DESIGN AND SIMULATION TOOL

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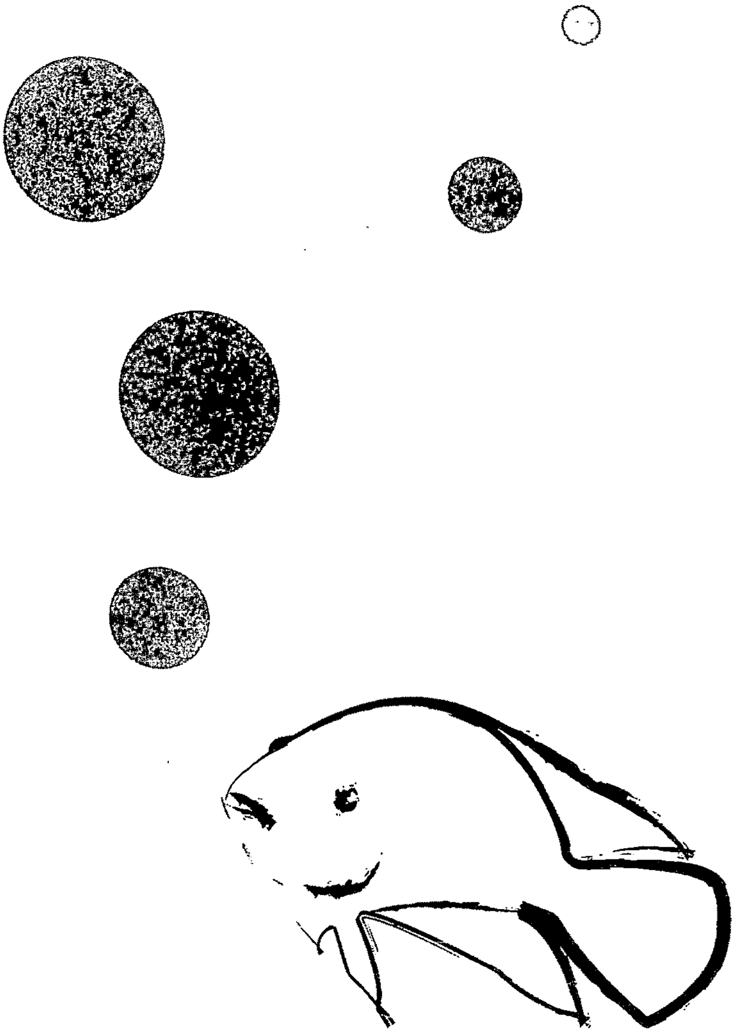
Fishing gear and aquaculture facilities consist mainly of netting, ropes, floats, and sinkers and they are generally considered as flexible structures. The features of these structures are bound to be affected by various forces in the sea environment and will change shape accordingly. A computerized modeling and simulation of the structure is essential for understanding the movements, designing an appropriate system and controlling it.

This paper describes a model for the underwater flexible structures and presents its simulation methods. In this paper, flexible structure is divided in to finite elements, and the structure consists of a finite number of particles to model the system, and then describe it, considering it as a physical system where these particles are connected as an elastic line. The elements of a structure can be modeled using the mass-spring model. The model is described as a nonlinear and stiff system by considering the elasticity of the lines and external forces.

An implicit method is used for the numerical integration of the system. It is found that this method offers low computational time and a stable solution. Also introduced is an algorithm to design various flexible systems using computer graphics, an automatic model creating system from the designed plan and a three-dimensional graphics tool that can show the calculated results. Application examples in design and simulation for the commercial fishing gears are presented.

Socio-economic Perspectives



SUSTAINABILITY, ECOLABELLING AND ASIAN FISHERIES

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Wild capture fisheries provide a livelihood to many people in Asia, and millions as their primary source of protein. The pressures on the stocks they rely on are varied, but with increasing demand and trade, both within Asia and with the rest of the world, these pressures, will only increase if not addressed properly.

The Marine Stewardship Council (MSC) is a global non-profit accreditation and standard setting body that operates a certification and labelling scheme for commercial fisheries. The MSC was established in 1997 to make use of market forces as an incentive for sustainable fishing. Since the MSC's inception, 10 fisheries from various parts of the world have been certified as sustainable. These account for approximately 4% of the total global wild capture fisheries, an encouraging figure in such a short time. There are currently another 14 fisheries at various stages in the certification process.

The MSC has direct experience with not only the complex task of evaluating fisheries and with the marketing of these products to individuals concerned about the consequences of poor fisheries management. Our experience shows that in Europe there is sufficient demand to act as an incentive for seafood exporters from the Asian region to get involved in certification. As a result, we have seen a growth in interest in benefits of certification in Asia. Consumer interest in the source of their seafood is also increasing. New legislation in the European Union will require that by 2005 all seafood entering the EU be traceable back to its origin.

Major seafood buyers are now making bold statements in their Corporate Reporting, and corporate social responsibility is now playing a major part in the drive to purchase seafood that is sustainable. Several have placed strict deadlines on when in the future they will source seafood only from sustainable fisheries. Several major global retailers are also following this trend

To date there are over 200 different MSC labelled products in 17 countries around the world, and as more fisheries become certified, we expect this figure to rise substantially.

The MSC program has great potential to work with new and already existing approaches to fisheries management in the Asian region. The organization operates within national frameworks determined by that government, and addresses the concerns of all stakeholders.

Our experiences to date in Asia have been encouraging, and not only from the more 'developed' nations. We recognize that there is an interest amongst governments, managers, fisheries, processors, retailers and consumers that is worthy of further development.

PUBLIC AND PRIVATE SECTOR INSTITUTIONAL ARRANGEMENTS IN FISH GENETIC RESEARCH AND DEVELOPMENT: ISSUES AND RECOMMENDATIONS FROM PHILIPPINES CASE STUDY

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Growth of tilapia industry in the Philippines and elsewhere in the region is attributed mainly to development of genetic improvement technologies and improved tilapia strains by public sector institutions. As institutions move towards further development, undertake widespread dissemination, and engage in commercialization of improved tilapia strains, it has become necessary for some of these public sector institutions to establish partnerships with the private sector. Unlike in crops, the subject is still new in fish and information on changes that take place with evolving partnerships/changes in source of funding is not known. An 18-month research conducted in the Philippines evaluated the effects of changing partnerships/source of funding on genetic research and dissemination of research outputs to end-users, through field surveys, gathering of secondary information and organization of stakeholder workshops.

The late 1990s witnessed greater private sector participation not only in dissemination of improved tilapia strains and in research. Concomitant with this development are changes that have taken place, including differences in nature of genetic research and developmental activities; ownership rights to improved tilapia strains; and emergence of issues that influence dissemination of and access to these strains. These changes are most evident in the program concerning the Genetically Improved Farmed Tilapia (GIFT) strain, it being the only one that has established an alliance with a *for-profit* private sector company.

There is divergence in breeding goals due to difference in focus of clientele farmers during the public sector phase (GIFT project) and private sector phase of GIFT breeding research (GenoMar-GIFT Foundation). Dissemination mechanism, which specifically targets "small and poor" tilapia farmers, is lacking. Among farmers involved in hatchery operation, those with relatively higher level of education, access to investment capital and own larger areas of land are in a better position to receive the benefits of genetics-based technology from private sector collaboration. Linkages among research institutions, local government units and fishfarmers are generally weak, suggesting the important role that farmers and private sector producers can play in the delivery of technical information.

While significant benefits have been achieved as a result of development of improved tilapia strains and public-private sector partnerships, a number of issues need to be addressed. Recommendations arrived at from stakeholder workshops are presented in the paper.

USER VALUES OF AQUATIC RESOURCES IN THE LOWER MEKONG BASIN: EMPIRICAL EVIDENCES

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This paper highlights the social and economic values of aquatic resources in the Lower Mekong Basin in Cambodia. The study conducted household surveys, participatory rural appraisals and key informant interviews in eighteen villages of three provinces: Siem Reap, Takeo and Stung Treng. To understand the values of aquatic resources to the rural households, the study adopted different techniques of data collection: survey of sample households, participatory rural appraisals and longitudinal monitoring of randomly selected households. Questionnaires were developed in consultation with relevant department of fisheries officers, provincial officers, village leaders and stakeholders while data were checked and verified through return visits. Results show that on average 69 per cent of the respondents depend on aquatic resources for their income and livelihood. There is a distinct variation in terms of dependence on the aquatic resources between the poor and rich households. Almost 71 per cent of the lower income households depend on aquatic resources for their income compared to 51 per cent of the higher income households during wet season. The study also showed that on average 91 per cent depend on aquatic resources for meat food and approximately 45 to 55 per cent depend on aquatic vegetation. Other uses include dependence on aquatic resources for medicine, transportation, irrigation and cultural and recreational purposes.

ECONOMIC LOSS FROM FISH DISEASES ON RURAL FRESHWATER AQUACULTURE OF BANGLADESH

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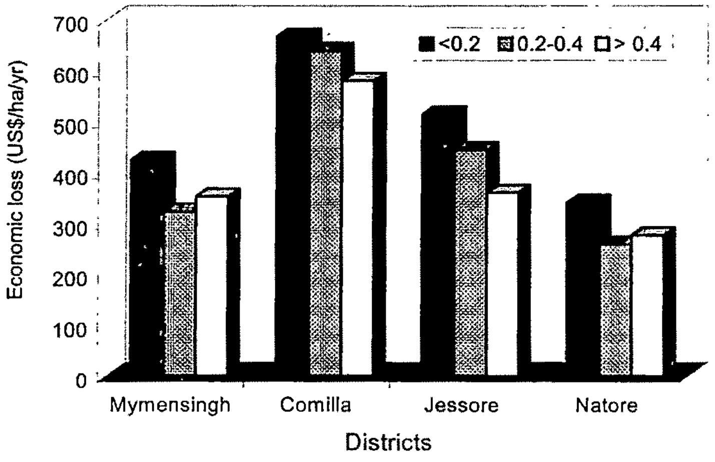
Prevalence of fish disease has negative economic impact on aquaculture but the extent of this impact is not well documented. In order to quantify economic impact of fish diseases in rural freshwater aquaculture, a questionnaire survey and participatory rural appraisal (PRA) tools were used in four districts of Bangladesh. A total of 326 fish farmers were interviewed and 20 PRA sessions were conducted. This study indicated that there is economic loss of approximately 18% to farmers from diseases. These losses varied with among districts and with the size of farms. The average loss as high as US$581 ha/year was observed with the fish farmers of Comilla districts followed by Jessore U$440, Mymensingh US$367 and Natore US$291. Fish production varied among different districts. The average highest percentage (27.3) of loss of actual production was seen in Comilla district while the lowest (8.1%) was with farmers from Natore district. In general, small size farms (<0.2 ha) suffered highest average loss (27.1%) than the bigger size farms (14.5% for medium and 12.7% for arge farms).

The most prevalent disease was tail and fin rot (18.28%) followed by epizootic ulcerative syndrome (14.58%), malnutrition (13.3%), red spot (10.46%) and gill rot (10.06%). Other conditions like dropsy, argulosis, air gulping and white spot were also reported by the farmers but with lower incidence frequencies. The disease occurred during the winter seasons. This study, thus, demonstrated that there are substantial economic loses to fish farmers due to diseases and therefore, further work is needed focused on the development of strategies for farmer-oriented primary fish health management packages.

Economic losses (US$/ha/year) of freshwater aquaculture at different districts of Bangladesh. Farmers were divided into three groups: small (0.2 ha), medium (0.2-0.4 ha) and large (>0.4 ha). Number of respondent: Mymensingh-88; Comilla-84; Jessore-94, Natore-60. (1 US$ =Tk.58).



ECONOMIC VALUATION, ACCESS ANALYSIS, AND STAKEHOLDER-BASED PLANNING FOR AQUATIC RESOURCES MANAGEMENT IN THE LOWER MEKONG BASIN

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The WorldFish Center, with funding from the Department for International Development (DFID) of the United Kingdom and in partnership with the Department of Fisheries (DOF) of Cambodia and Non-Governmental Organizations (NGOs), conducted the Aquatic Resources Valuation and Policies for Poverty Elimination in the Lower Mekong Basin Project in 2003-2004. The overall goal was to reduce poverty and improve livelihoods of poor people dependent on aquatic resources in the Lower Mekong Basin through the development and implementation of stakeholder-based aquatic resource management policies and plans. The project was implemented in selected villages in three provinces in Cambodia: Stung Treng, Takeo, and Siem Reap.

Employing economic valuation, the project found that aquatic resources in the Lower Mekong Basin have diverse uses to the rural communities. Aquatic resources provide the basis for livelihood activities such as fishing, aquaculture, collection of plants and animals, collection of wood, fish processing, fish marketing, duck culture, raising and maintenance of livestock, irrigated rice farming, transportation and other direct uses. Furthermore, aquatic resources in general are utilized by rural communities and households for domestic water supply and recreation as well as provide biodiversity support and other non-market services.

While the uses of aquatic resources in the Lower Mekong Basin are many, the access analysis done by the project indicated that the ability of rural communities to actually utilize these resources is impaired by important constraints. Among others, these include physical limitations such as the existence of fishing lots and fish sanctuaries; technology-related constraints particularly the antiquated fishing gears and techniques used by small-scale fishermen; financial limitations such as the lack of credit to purchase new fishing gears and equipment; and institutional factors including poor monitoring and enforcement by the authorities regarding illegal fishing operations.

Given the significant value of aquatic resources to the rural households and communities and the access constraints facing them, the project initiated a process of developing local level and stakeholder-based policy plans for the improved management of aquatic resources in the villages it covered. The plans were done with the active participation of different stakeholders, including the village households; village, commune, district and provincial officials; fishery community committees; local and national NGOs; and DOF provincial and national staff. The plans were recently completed and presented to the stakeholders in the villages.

SOCIOECONOMIC IMPACT OF AQUACULTURE EXTENSION PROJECTS IN IMPROVING LIVELIHOODS OF FISH FARMERS IN BANGLADESH

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Aquaculture Extension Projects (AEPs) were implemented in Bangladesh to increase fish production and to improve the livelihoods of fish farmers. With this end, the main objective of the present study was to assess the sustainability of these AEPs and their socioeconomic impact on improving the livelihoods of fish farmers. The present study selected seven AEPs which together covered most districts of Bangladesh. However, considering the scale and magnitude of operation of AEPs, and involvement of working organization and partner NGOs, in total 620 fish farm households were selected from 13 districts covering 138 villages in Bangladesh. Data were collected for the year 2002-2003 and most analyses were done by using 'before' and 'after' method to determine the socioeconomic impacts and sustainability of the selected AEPs.

Through extension and motivation, AEPs suggested fish farmers to adopt scientific culture and management by using required amount of feed and fertilizer. The study revealed that most of the fish farmers adopted semi-intensive farming and their average yield and net return were 3445 kg. ha-1 and 90569 Tk. Ha-1 respectively (US$1=Tk 60).As the main objective of the present study, socioeconomic impact of AEPs in improving livelihoods of fish farmers have been analysed. With the effect of AEPs farmers introduced improved culture and management to increase yield and economic returns of aquaculture which contributed about 16% of household income (Tk 140527) and that also ensured more expenditure on basic need to improve their household security. Per capita fish consumption of farmers' family members also increased from 38 to 45 gm/day.

AEPs created employment opportunities for farm households because adoption of improved technology resulted higher yield which made involvement of more labour for different fisheries activities. Gender wise labour involvement indicated that household women actively participated in aquaculture management since the fish pond and other water bodies were around their homestead areas. Development of improved culture had indirect effect on increased involvement of women in household production activities such as vegetable production on pond dyke which strengthened their household income. In sharing productive activities, farmers made their household decision on different aspects of pond fish production after consultation with their wives. Livelihood assets such as human capital, social capital, natural capital, physical capital and financial capital were interrelated and had significant impact on the improvement of the livelihoods of fish farmers. In case of changing livelihood, no capital acted alone as causal factor, rather different types of highly dynamic relationship among the capital were responsible for a sustainable livelihood. After implementing AEPs, fish farmers had more access to these capital assets and their socioeconomic condition has improved. Increased fisheries income and employment opportunity enabled the fish farmers to spend more than before in different livelihood capital.

TOWARDS SUSTAINING MARINE AND FISHERIES CONSERVATION: ECONOMIC VALUATION FOR CONSERVING THE TUBBATAHA REEFS, PHILIPPINES

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The emergence of the global trend towards ecosystem-based fisheries management (EBFM) and the imperative to conserve biodiversity; have highlighted the important role of establishing and maintaining marine protected areas (MPAs). However, this will require budgetary allocation from concerned governments/ parties. In most cases, as Dixon and Sherman (1990) pointed out, the costs of protection/ conservation receive thorough coverage, whereas the benefits from it are only partly accounted for, as such efforts and resolve towards marine conservation are frequently lacking or not sustained. Aside from non-marketed benefits, non-use values are usually not reflected in policy making and decision making concerning resource allocation for fisheries resource management.

This study focuses on the measurement of non-use values for conserving Tubbataha Reefs, a UNESCO world heritage site and world-renown diving spot, which is believed to be a rich spawning ground of various fish species over the Sulu Sea, Philippines. A dichotomous choice contingent valuation survey was conducted using the personal interview approach among 1200 respondents from Cebu City and Puerto Princesa City, Philippines. Results of the Turnbull willingness to pay (WTP) estimator showed that average willingness to pay was 285 pesos for Cebu City and 496 pesos for Puerto Princesa City. Using these figures to compute social WTP, the non-use values for conserving Tubbataha Reefs amounted to about 58 million pesos, which is more than enough to cover the conservation costs of 10 million pesos. The empirical evidence of non-use values provides strong rationale for regular budgetary allocation for the conservation efforts, whether it comes from the Philippine government or other sources.

AN EVALUATION OF THE EFFECTIVENESS OF A CHILD TO CHILD EXTENSION MODEL FOR PROMOTING EFFECTIVE POND AQUACULTURE IN RURAL BANGLADESH

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This model of child to child extension was developed as a supplement to an adult training programme aimed at enhancing effective pond aquaculture in rural communities. Adult trainers from the Department of Fisheries (DoF) felt unqualified and uneasy to teach children. As a possibly more effective alternative, 247 graduate girls (*kishorees*) from the Non Formal Primary Education programme (NFPE) of the Bangladesh Rural Advisory Committee (BRAC) were recruited and trained by DoF staff. The programme was linked to 1,254 BRAC NFPE schools located in 896 villages. Participating children were selected on the basis of their family owning or having access to a pond and groups were limited to 10 with an equal gender divide. Being a pupil from a BRAC NFPE generally ensured that the programme had a strong poverty focus. In total 14,690 BRAC school children received six sessions of training and took home two games promoting key lessons to play with family and friends.

An impact study of knowledge transfer and its translation into practice was conducted in 38 villages associated with the programme over one year. A scored assessment of indicator words, knowledge and practice was asked of about 2,500 randomly selected people of all ages and social status on five occasions. In addition focused group discussions were held on the final sampling occasion to assess more general impact and views of the child to child extension programme. The rate of knowledge transfer was fastest during the first 16 weeks after training. In terms of increased fish production this was highest amongst the families of trained children with 63% of parents reporting that they had followed the information provided by their children which had resulted in increase in production frp, 754 kg/ha^{-1}/yr^{-1} to 2,008 kg/ha^{-1}/yr^{-1} from and average size pond of 0.1 ha^{-1}. There was also a reported annual increase in fish consumption of 23kg per family among this group. Within the communities after one year 30% of respondents knew of the programme and/or seen the games played and only 10% of pond farmers claimed that they had been motivated to actively improve their pond management techniques.

INSTITUTIONAL ARRANGEMENT ANALYSIS (IAA) OF INDIAN SHRIMP FARMING – STAKE HOLDERS CHARACTERISTICS AND THEIR ATTRIBUTES ON ISSUES OF SUSTAINABILITY IN SHRIMP FARMING SECTOR

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India is the 5th largest producer of cultured shrimp in the world and accounted for over 100,000 tons during 2002-2003. In the last decade cultured shrimp production witnessed a growth of 10.4% per annum and developed as a major activity in some of the coastal states. However sustainability in the sector is still far from satisfactory. Understanding of existing institutional arrangements by way of identifying main stakeholders and their roles and responsibilities in the back ground of development of the sector, underlying driving forces influencing decision processes, interest and perception of different stake holders on major issues including policy and legislative frameworks to bring in sustainability are very much lacking. The present study addressed these issues by way of generating data through field survey, consultation and interviews of different stakeholders adopting participatory tools, secondary data collection etc., and analysis using logical frameworks.

The findings of study indicated farmers/producers (small and large), input suppliers (seed, feed, chemical / health care products, credit), processors and traders (buyers, processors, exporters), researchers, government officers, local community (local elites, politicians), NGO's functioning at local, regional and national levels are the main stakeholders of the sector. Large farmers, national level input supplier's, processors and traders/exporters are the core stakeholders by virtue of holding high power, risk exposures and externalities. Small farmers, local input suppliers, processors and bankers are vulnerable groups, local elites, politicians, planner and tutorials are privileged categories, local/national NGO's, and scientists as other categories of stake holders with medium level of influence on the sector.

The established attributes viz., interests and perception of key stakeholders on issues of sustainability revealed dependence of most farmers, inputs suppliers, processors and traders on shrimp farming activities as source of income, and identified researchers, planners, local elites, politicians and NGO's as players involved mainly in promotional activity of the sector. Most stakeholders perceived increased local wealth followed by increase in employment, foreign exchange and rural income as major benefits associated with shrimp farming.

The major issues that are threatening sustainability of farming system viz., disease out breaks, environment and social issues, the nature and cause of problems, over coming strategies, needed institutional arrangement to address the issues and implement appropriate solutions as perceived by the key stakeholders of the sector are discussed in the paper.

RESEARCH ON TECHNOLOGY DISSEMINATION: WORLDFISH CENTER EXPERIENCES IN BANGLADESH

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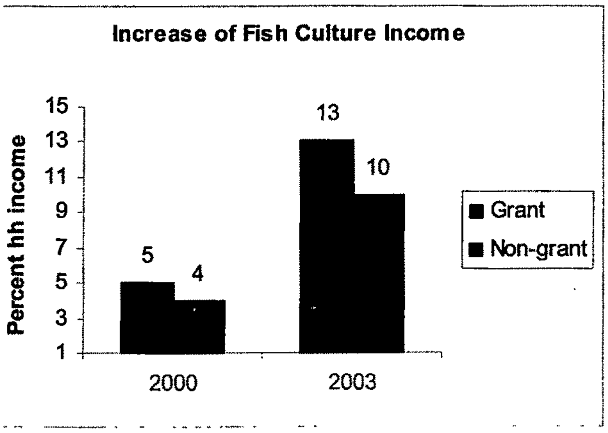
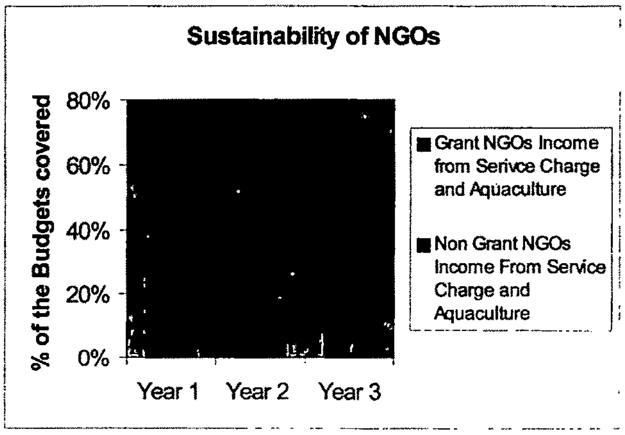
The WorldFish Center has been working in partnership with NGOs since 1987 in Bangladesh. Currently the Center works with 33 NGOs under the Development of Sustainable Aquaculture Project (DSAP), a five-year project sponsored by USAID. This project disseminates low-cost technologies appropriate for small-scale farmers developed by previous projects. The diffusion of technologies is participatory (bottom up), which ensures active participation and empowerment of cooperating farmers.

The objective of the project is to increase fish production and income as well as improve livelihoods of the small-scale famers through aquaculture. Since 2000, the project worked with 48 partner NGOs, trained 444 extension staff and supported 43,739 aquaculture demonstrations. The demonstration farmers are organized in 4,316 groups. In 2004, the project is collaborating with 33 NGOs, trained 258 extension staff, supported 50,794 demonstrations of the group members (including secondary adopters), covering 6,800 ha. Production is expected to reach 17,000 t. The farmers' production increased by 3-4 times (average 2.7 t ha^{-1} in 2002) and financial return by 4-5 times. Women participation is successfully increased using the Whole Family Approach (WFA) in 2004.

The project provides technical assistance, training of trainers (ToT) and financial support to the partner NGOs. Besides sustainable production by the farmers, the project also aims at sustaining the NGOs aquaculture extension program. Financial sustainability is achieved through Income Generating Activities (IGA) that focus on income from service charge for the extension services provided and from aquaculture activities (fingerling and table fish production). The results of the study and the lessons learnt from this innovative approach are described.





PROFILES OF AQUACULTURE DEMONSTRATIONS UNDER DEVELOPMENT OF SUSTAINABLE AQUACULTURE PROJECT (DSAP) IN BANGLADESH

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The Development of Sustainable Aquaculture Project (DSAP) implemented by the WorldFish Center with funding support from USAID is aimed at improving the household incomes and life circumstances of resource limited people. The major thrust of the project is to bring unused and/or underused seasonal and perennial ponds and rice fields into improved production with methods that are feasible, affordable and acceptable to resource poor households in rural areas of Bangladesh, through demonstrations of improved, low-input fish culture technologies (carp polyculture, carp-freshwater shrimp polyculture and nursery) in ponds and rice fields in collaboration with NGOs.

Development of Sustainable Aquaculture Project (DSAP) is an action-cum research project. The action is in terms of disseminating tested low cost aquaculture technologies through rural fish demonstration farmers/households, providing them training and technical support on tested aquaculture technologies, integrated agriculture - aquaculture systems, household finance and group dynamics while the research is in terms of monitoring and evaluating the results of the technologies practiced and assessing the short and long term impact of these demonstrations on fish production, income, nutrition intake as well as skill development and decision making.

This paper examines the performance of the fish farmers as well as the adopted aquaculture technologies through information collected from 2,168 fish farmers' (10 % of total beneficiaries) during 2003-2004 aquaculture production cycle. The performance is examined in terms of main parameters such as production practices, productivity and income. The impact of different extension approaches being implemented by DSAP such as participatory (bottom up) versus top-down approaches and grant versus non-grant farmers is also examined in this study. Mostly descriptive analyses were made to present the findings of the survey. However, some graphical analysis as well as statistical correlation and t-tests were conducted wherever found necessary. The paper shows that the low-cost technologies practiced under DSAP are highly profitable and providing substantial benefits to the poor farmers.

SOCIO-ECONOMIC CHARACTERIZATION OF INLAND FISH FARMERS OF KARNATAKA, INDIA: A CASE STUDY

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Karnataka, located in south central India, has rich inland water resources, which include around 40,000 tanks (small reservoirs) and large numbers of medium and major reservoirs. Inland fisheries have the potential to diversify livelihood opportunities, especially for small-scale and marginal farmers and the land-less. The potential of inland fisheries production has been estimated to be about 264,000 metric tons, valued at Rs 10,000 million (approximately US$ 220 million). Inland fisheries activities create income in rural areas and are often carried out by people of low socioeconomic status. A study was conducted in seven selected districts of Karnataka to characterize the socio-economic status of inland fish farmers. A total of 260 fish farmers using common property resources (CPRs:- predominantly leased tanks) and 40 farmers having individually owned ponds were identified and interviewed for this study using formal and semi-structured survey methods.

There was a striking difference in the social status of the two groups. The majority of the farmers using CPRs belong to small-scale and marginal farmers and landless categories, and came from the scheduled castes and tribes, while most of the farmers who had their own ponds were from higher ranked socioeconomic groups. The common characteristics of the two groups were that both were relatively young had at least primary level education. The majority of them had been practicing fish culture for last five years. The most commonly used fish species were common carp and Indian major carps (catla, rohu and mrigal), with Chinese carps being used occasionally.

The per capita income of the families engaged in inland fisheries was about Rs 25,000 (US $ 550) and Rs 15,000 (US$ 330) per annum against the State average of Rs 10,300 (US$ 230). More than 60 per cent of the per capita income of these farmers across both the groups was contributed by inland fisheries indicating its importance to their livelihoods. The results of the survey are discussed in the context of the potential for improved inland fisheries to enhance the livelihoods of the rural poor.

RESOURCE ALLOCATION EFFICIENCY OF THE CARP-FRESHWATER PRAWN *Macrobrachium rosenbergii* CULTURE FARMERS OF BANGLADESH

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Culture of carps along with freshwater prawn (*Macrobrachium rosenbergii*) is a prominent practice among farmers in Bangladesh. While carp species are mainly for domestic market, *M. rosenbergii* is mostly exported. This culture practice is mostly concentrated in the southern district of Bangladesh. Data collected from 105 demonstration farmers under the Development of Sustainable Aquaculture Project (DSAP) implemented by WorldFish Center in Jessore district of Bangladesh is used in the study. The study was undertaken to investigate farmers' efficiency in resource allocation in this polyculture practice. Data Envelopment Analysis method was employed to estimate the efficiency scores as well as allocation of resources. Relationship of efficiency scores with pond size and feed application was also investigated. The study revealed a mean technical efficiency of 85%, which is much higher than allocative efficiency (57%) and cost efficiency (49%). Fifty percent of the total sample was technically efficient while only 9% was allocatively and economically efficient. Findings indicate that economies of scales can be achieved from area expansion. While technical efficiency had a positive relationship with pond size, it displayed negative correlation with allocative efficiency indicating that smaller pond owners are allocatively more efficient. Adjustments in actual input allocations were seen necessary in order to match with technical and cost efficient levels. Actual input application tended to be higher than technically efficient level in general while it was higher for some inputs and lower for others as far as allocative efficiency was concerned. The study concluded that achievement of technical efficiency in this polyculture production system could be a concern in the short run but the farmers are to be economically efficient in the long run. Similar studies are needed in different agro-ecological zones of the country to come up with cost efficient levels of inputs application and train the farmers in proper input use to enable them to produce at cost efficient level.

IMPACT OF THE SUPREME COURT JUDGEMENT ON SHRIMP FARMING IN INDIA

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The study was undertaken in south Tamil Nadu coast where shrimp farming is predominantly taken up in Coastal Regulatory Zone (CRZ) or lands adjacent to CRZ mostly using seawater, as the basic aim of the Supreme Court intervention is to regulate shrimp farming activity in CRZ for attaining eco-sustainability. In all 40 stakeholders representing shrimp farmers, labourers in shrimp farms, agriculture farmers, input suppliers, processors, bankers and local elite were interviewed. The information was elucidated using restructured questionnaire on aspects of awareness about the Supreme Court intervention ; positive impacts of shrimp farming practices with reference to area and production, employment generation, infrastructure development and export promotion; impact on environment and land resources; soil solization and agriculture; land utilization and land value and alternative policy suggestions for controlling and improving shrimp industry. The study indicated that majority of stakeholders do not have clear idea about the purpose of the Supreme Court intervention. The farmers have learnt through experience that extensive or modified extensive farming system with 5-15pcs/m^2 is better. The area under shrimp farming has not decreased because of intervention of the Apex Court. The negative impact on environment, agriculture, marginalization of poor, land utilization for agriculture did not exist and instead shrimp farming has a positive impact on employment generation, use of barren coastal lands, rural infrastructure development and social and economic aspects of different stakeholders, thus suggesting that the Supreme Court intervention did not affect the shrimp industry in the study area.

IMPACT ANALYSIS OF FISH TRADE LIBERALIZATION ON INCOME AND INCOME DISTRIBUTION IN THE PHILIPPINES

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A bioeconomic supply and demand model for the Philippine marine fisheries is developed. Welfare analysis is performed using various assumptions of the state of capture regimes (open access or regulated) and the level of liberalization. Trade liberalization in fishery products is expected to lower the domestic price of fish, thereby discouraging domestic fishing and leading to potential resource regeneration. Liberalization increases the welfare of consumers but at the same time displaces fish workers. These impacts feed into the income distribution and poverty profile of Filipinos. Net gains from trade can hardly be translated into the mitigation of the adverse impacts due to weak institutional mechanisms.

AN ENQUIRY INTO THE CONTRIBUTION OF THE FISH MARKETING AND DISTRIBUTION SYSTEM TO ECONOMIC INDICATORS IN THE KHULNA CITY OF BANGLADESH

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A number of wholesale and retail fish markets in Khulna city (Bangladesh) were studied using quantitative and qualitative data collected at each point. The qualitative data included a description of the markets and the traders operating in it, the typical nature of indebtedness and any associations or co-operatives based at the market. The quantitative data included information on the number of traders and their costs, business revenues and net incomes. In the Khulna fish distribution chain the *aratdars* (the commission agents) who organize the wholesale markets were able to collude to control the passage of fish through the *arats* (wholesale markets) in the city. The structures in the fish marketing chain in Khulna were predominantly competitive. The distinctive stages in fish marketing were: (1) fish catching, (2) fish collecting/assembling, (3) fish wholesale in *arats* and (4) fish retailing. Fish catchers were numerous, dispersed and had inadequate finance. Two types of participants performed the function of gathering the fish and transporting it to the Khulna market i.e. Mahajans and Beparies. Mahajans were independent traders most of whom owned vessels and gears used by the fishermen. Aratdars charged a commission of 2% or more on sales by independent customers but 5-7% on sales by borrowers. Retailers were numerous and varied in their scale of operation and income. Economic Value Added/Costs were very low. Economic Value Added/kg in the retail markets in Khulna were 16 taka per kg, the *arats* 3 taka per kg. Much of this difference may be linked to the volume of product handled. 10%-40% of the retailers who bought at an *arat* did so on credit while 50%-70% of the sellers had benefited from an advance from the aratdar. Retailers were generally able to buy from the cheapest source. The loans to collectors were, at least potentially, more anti-competitive. Again, the loans were typically short term (7-10 days) and large amounts have the potential to distort the market. Although the rates of interest charged on the loans were extremely high – probably in the order of 2.5% for a 7-10 day loan, which was about 200-350% per annum – the loan was of high risk. The maximum value in Herfindahl-Herschman Index was 10,000 (the square of 100% in a monopoly situation) and the maximum value approached zero (when there were an infinitely large number of enterprises in the industry). In the more controlled situation at the Skid Ghat no 5 market the value was about 800. A qualitative judgment was that entry into most activities in the fish marketing chain in Khulna was not difficult. By itself membership of co-operatives and associations was not a restrictive practice, but if an association was active there was an indication that it exercised its power in some respects which in turn facilitated the use of commercial might in other areas. The Retailers Co-operative at New Market had demonstrated the power that could come with collaborative action, but against its landlords, the Khulna Development Association, not the wholesalers or customers. The results of the research had been used in the 2001-2002 fisheries sector review in Bangladesh. Some of the tools developed in the present investigation are ready for application in the context of decision making in development strategies.

THE SUSTAINABLE LIVELIHOODS APPROACH OF FRESHWATER PRAWN MARKETING SYSTEMS IN BANGLADESH

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An investigation was carried out in southwestern Bangladesh to understand existing practice of freshwater prawn marketing systems with the livelihoods of traders and associated groups. The livelihoods of a large number of people are associated with prawn distribution and marketing systems. Prawn marketing is almost exclusively a preserve of the private sector. The market chain from producers to consumers passes through a number of intermediaries: field workers, prawn traders, agents and processing companies. Finally processing companies export frozen headless prawns in individual and block frozen form to international markets. The freshwater prawn is a highly valued product for international markets, and almost all prawns are therefore exported, particularly to the USA, Japan and Europe. A typical processing company exports an average 4.5 tons of prawns daily during November to January. The average selling prices of prawns varied from US$ 3.5 to 7 lb^{-1} (US$ 7.7 to 15.4 kg^{-1}) in 2003, depending on grade (Table 1).

In spite of poor marketing facilities, livelihood outcomes are positive and most of the households of traders (80%) have improved their social and economic conditions through prawn marketing. Traders have broadly improved their food consumption, standards of living, purchasing power, choice, and ability as an economic sector. However, concerns arise about the long term sustainability of their livelihoods due to higher transport costs, poor road and transport facilities, poor supply of ice, lack of money for this business, lack of training facilities, poor institutional support and inadequate extension services. It is essential to provide the necessary institutional and organizational supports and extension services for sustainable prawn marketing systems.

Table 1 The average prices of headless prawns from processing companies to international markets.

Grade	No. of headless prawns lb^{-1}	Average prices	
		US$ lb^{-1}	US$ kg^{-1}
U-5	Less than 5	7	15.4
5/7	5 - 7	6.5	14.3
8/12	8 - 12	6	13.2
13/15	13 - 15	5.5	12.1
16/20	16 - 20	5	11.0
21/25	21 - 25	4.5	9.9
26/30	26 - 30	4	8.8
31/50	31 - 50	3.5	7.7

IMPROVING UNDERSTANDING OF MARKETING INTERACTIONS AND THEIR IMPACT UPON THE POOR: A CASE STUDY OF SMALL SCALE AQUACULTURE IN NORTHWEST BANGLADESH

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Aquaculture development is often tasked and supported with the intention of benefiting the poorest sections of society. If this is to be realised it is essential that the overall impact and dynamics of marketing within the aquaculture sector on producers, consumers, and other channel intermediaries are clearly understood. However, in many cases, the existing formal and informal fish marketing activities and functions are unknown. Any benefits of research and development are often badly targeted or may even have negative impacts on the poor, the intended beneficiaries. This paper presents the findings of a thematic study on existing marketing of farmed fish which aims to develop a clearer understanding on the impact and interaction of marketing of famed fish in Dinajpur district in Northwest Bangladesh and to identify the benefits of marketing and their transfer to the poor.

A process-led approach was followed in the study, where participatory rural appraisal (PRA) tools were the primary approach adopted to collect data and information. These data were supplemented with directed semi-structured questionnaires and case studies during January-July 2004. Four villages were selected for survey in collaboration with GO-INTERFISH Project, Care Bangladesh. In addition, marketing chains and markets which were used by Telipara farmers were studied in depth.

Whilst farmers commonly viewed markets as a back-up mechanism to satisfy any immediate, and possibly unexpected, need for money, they also recognized the longer term role of markets within their livelihoods. Slightly more than one third of the total food fish produced from aquaculture systems (rice-fish plots and ponds) in the four sample villages was consumed by the farming households. In one extreme, Gongapur, fish consumption amounted to 60% of total food fish production due to the dominant religious-cultural and traditional practice of the resident Hindu families. More commonly the remaining two-thirds of production not consumed by the household were found to be sold either at the farm-gate or markets. Interestingly, the research found no link between the amount of fish sold and the distance of the village from either the district town or from markets, particularly auction markets.

The study revealed significant variations in the marketing activities, decision making processes and the channels used for aquaculture products. Importantly, detailed exploration of these alternative pathways to market highlighted the extent of employment generated. When coupled with the income thereby created and the support ensuing for other sections of the local economy and society, a more deep-seated perspective on the marketing function begins to emerge. Apart from these associated linkages to welfare gains, markets also provide more central mechanisms for the allocation of products. Distinct species preferences were found by different consumer groups and these too could help determine policy decisions regarding future aquaculture development. In addition to facilitating the allocation of supply to demand, markets create and support an information network which is central to marketing decision making and wider, more fundamental communications within the community. It may thus be concluded that marketing interactions and benefits are commonly much more trenchant within society, and especially its poorest sections, than often is suggested through a simple consideration of product flows alone. Understanding more of the detail of such mechanisms clearly represents a valuable opportunity to deliver yet more benefits through aquaculture.

QUALITY OF SHRIMP IN THE DISTRIBUTION CHANNEL: AN APPROACH IN IMPROVING THE LIVELIHOOD OF FISHER COMMUNITY

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The research was undertaken to assess the socio-economic status of the stakeholders in the shrimp distribution channels and quality of shrimp as normally practiced presently in Khulna region of Bangladesh. An approach in improving the quality of shrimp (by keeping shrimp in ice at a ratio of 1:1 throughout the channel) was conducted. The study areas were Bagerhat, Khulna and Satkhira districts and included 13 upazillias, 152 ghers (ponds), 86 farias (middleman), 210 depots, 22 agents and 8 processing plants. The investigation initially identified the distribution channels and the stakeholders. Transportation from harvest to processing plant was unsatisfactory in relation to materials, carriers and routes and the average handling period was 8 hours. Stakeholders were Muslims and were either illiterate or had primary education mostly. Shrimps were washed with water taken from ghers, rivers/canals by farias or in depots while shallow and deep tubewells were mostly used by agents and processing plants. Ratio of ice to shrimp used varied widely. Salary of the workers (ghers, depots) was poor but relatively higher in agents and processing plants. Quality of shrimp assessed (organoleptic, biochemical and microbial) was moderate to highly acceptable and did not differ much as practiced normally at present compared to shrimp stored in ice (1:1) in insulated box throughout the distribution channel. The agents exercised an exceedingly powerful role. Government and NGO's should intervene to minimize the powerful role of the agents through an acceptable strategy. This will lead to improving the livelihood and better communication between the stakeholders. Each stakeholder should come under one apex body and must comply with all the requirements set by shrimp seal of quality (environment friendly, traceability, food safety, HACCP implementation, human rights violation) as desired by buyers in the international market.

SHIFTING CENTRE OF GRAVITY? DESTINATION AND PRODUCT DIVERSIFICATION IN SOUTH ASIAN SEAFOOD EXPORTS

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The demand is growing for fish and fishery products and exporters are changing their markets in rapid tempo, to achieve higher profit margins via the diversification. This paper briefly reviews the destination and product diversification trends, especially the south Asian exporter's behavior of passing over the Japanese market. Special attention is paid to explore the market trends towards niche markets i.e. catering to ethnic markets in Europe, USA, Australia and Middle East. The discussions of past events and future issues are based on a combination of literature reviews, secondary data analysis and interviews with individuals in the industry.

Japan, the south Asia's prime market, has been facing drastic decline (in1997 south Asia's share in Japanese market was 25.37% which in 2003 declined to 14.07%) of exports from India, Bangladesh, Sri Lanka and Pakistan. The past decade has witnessed a dramatic change in Japanese fish consumption pattern, concomitant with a decrease in fish imports and a surprising shift in consumer preference towards budget size, low priced frozen seafood products than sashimi. Japanese market's crying demand for fresh fish has made limitations to South Asian exporters and this lead more towards to the EU and USA market. In the meantime China is becoming a wealthier market with increasing economic strength and living standards. The EU represents an affluent market (3.6% average annual increase) and demand for seafood is on the way up with stricter rules for hygiene and sanitary control (HACCP), traceability and environmental concern (eco-labeling).Trend analysis shows that south Asia exports to EU increase annually by 2.5%. Not, surprisingly, USA seafood market expanding annually at 2% for south Asian products offers more opportunities to shrimp and tuna (shrimp ranked 1st of the top ten seafood consumed in USA [8.14Kg/person/year]). Despite the great potential the sector is faced with many daunting challenges mainly with Non Tariff Barriers. Penetrating to new markets with diversified product range and promotion of brand names are the emerging business strategies that are explored. In addition to catering to existing markets, south Asian region started to tap the large ethnic markets. Processing of raw material, often in 2nd grade, low value species into value added, ready to cook or eat consumer packs with inherent spicy taste is a thriving industry in south Asian region and India is the largest single player there (annual increase of Maldive fish exports is 3.6% and sprats is 2.1%). Growing south Asian ethnic markets in Europe, North America, Australia and Middle East are tending to enhance seafood preparations. High- value forms have the best prospects in future markets with concern to consumer tastes and preferences.

EVALUATING RURAL CONSUMER PREFERENCES FOR INLAND FISH AND ITS SUBSTITUTES IN THE DRY-ZONE OF SRI LANKA USING PARTICIPATORY RANKING AND SCORING TECHNIQUES

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Participatory rural appraisal (PRA) methods have steadily gained ground with development practitioners, researchers and donors over recent years. At the same time these largely qualitative methods have attracted increasing criticism, particularly with regard to data validation. One of the main purposes of the study was to evaluate the use of quantitative perceptual ranking and scoring techniques within a PRA context in terms of speed, accuracy and amenability to statistical significance testing.

As a component of a wider market survey the authors investigated consumer preferences for inland fish and its substitutes by marginalised lower caste communities in rural inland areas. Precise phrasing of the survey questions was critical. Farmers were first asked about the product qualities which influence their *actual* household purchasing decisions. The next questions were personal and conditional; 'what fresh and processed products *would you most like* to consume? For triangulation purposes respondents were also asked to specify how often they consumed the different foods.

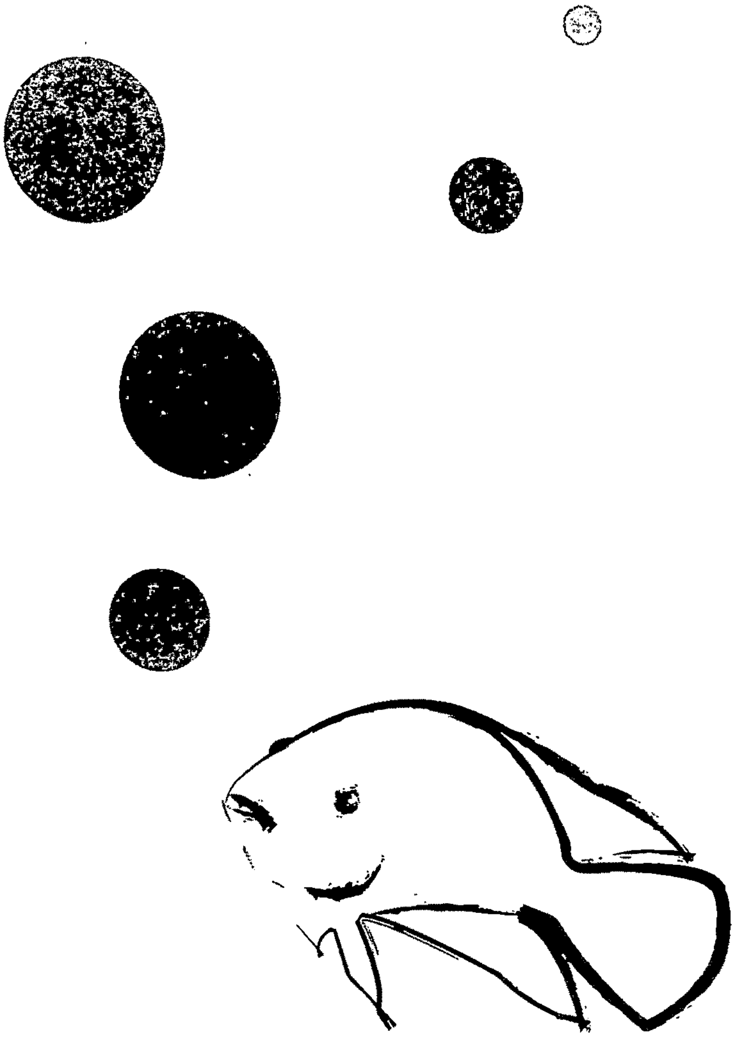
Based on a priori knowledge, the sample group of 204 respondents in six villages were stratified into four different interest groups based on age, gender, wealth rank and community membership. These independent factors were the basis of comparison in subsequent analysis. Results of both ranking and scoring techniques were subjected to Friedman's test, a non-parametric single factor analysis of variance. Significant outcomes were followed up by pair-wise testing using Wilcoxon's signed ranks test.

Two main limitations to the analytical methods are identified. Firstly the tests give little insight into potential interaction effects between independent factors. Secondly, because perceptual data can logically be only nominal or ordinal, median ranks rather than averages are used in these procedures i.e. scoring results are also converted to ranks implying wasted additional effort. A 'rapid pair-wise ranking' technique conferred two major advantage over scoring. First it was possible to assess a much larger number of criteria than conventionally recommended by adopting a pair-wise 'lowest and highest' ranking and exclusion procedure, while retaining logical consistency. Secondly, sample size and hence statistical rigour was improved due to time savings inherent in the method.

Results clearly demonstrated the importance of inland fish to rural food security. Fresh inland fish was consumed by 60% of all respondents at least once per fortnight and by 80% at least once per month. Some 75-85% of the total consisted of tilapias.

While overall inland fish were most popular, larger inland and marine fish were more popular than smaller sizes of the same varieties. However poorer households are much more reliant on small tilapia because of its lower cost. Current policies for the development of inland sector are discussed in the light of these results.

Understanding Aquatic Resources



TAXONOMIC STATUS OF MUD CRAB *Scylla* SP. IN BANGLADESH

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Mud or mangrove crab locally known as "Shila Kankra" in Bangladesh has been reported as *Scylla serrata* (Forskal, 1775) by various authors of this region (Kathirvel, 1981; Shafi and Quddus, 1982; Radhakrishnan and Samuel, 1982; Joel and Sanjeevaraj, 1983; Nandi and Pramanik, 1994; Zafar and Siddique, 2000). During our present study in the coastal areas of Bangladesh it was found that *S. olivacea* (Herbst, 1796) has been wrongly identified as *S. serrata*. The present observation reveals the following differential characteristics of *S. olivacea* with that of *S. serrata* observed by Radhakrishnan and Samuel (1982), Chowdhury and Hafizuddin (1991) and Keenan *et al.* (1998). Also, the means, standard deviations and ranges of two morphometric characters and twenty six morphometric ratios obtained from 66 *S. olivacea* over 95 mm internal carapace width were calculated which showed differences with that of *S. serratta* studied by Keenan *et al.* Therefore, the mud crab commonly found in Bangladesh is *S. olivacea*.

Table Major taxonomic and morphometric differences between *Scylla olivacea* and *Scylla serrata*.

Taxonomic characters	**Present observation on *Scylla olivacea***	**Observations by**			
		Chowdhury and Hafizuddin (1991)	**Radhakrishnan and Samuel (1982)**	**Keenan *et al.* (1998)**	
		Scylla serrata	***Scylla serrata***	***Scylla serrata***	***Scylla olivacea***
Color of carapace	Brownish to brownish green	Uniformly dark grayish grey	Dark green	Purple to greenish brown/black	Brownish to brownish green
Polygonal pigmented area	Absent	Not mentioned	Present on the last pair of walking legs and chelipeds	Present on chelipeds, all legs of both sexes and on abdomen of female	Absent
'H' mark on carapace	Shallow or less deep	Not mentioned	Deep	Not mentioned	Not mentioned
Frontal teeth	Rounded and shallow interspaces	Bluntly pointed	Pointed and anteriorly projected	Bluntly pointed and rounded interspaces	Rounded and shallow interspaces
Inner & outer spine on dorsal margin behind insertion of the dactyl	Inner spine present and outer spine reduced	Not mentioned	Not mentioned	Inner and outer spine present	Inner spine present and outer spine reduced
Spines at outer margin of carpus of cheliped	Absent	Not mentioned	Two stout spines	Two obvious spines	Absent
Morphometric characters	**Mean±SD**			**Mean±SD**	
CW (mm)	114.88±10.70			147.3±25.0	
ICW (mm)	110.48±10.09			138.4±23.2	

SELF-FERTILIZING MANGROVE KILLIFISH *Rivulus marmoratus* AS A MODEL FISH FOR MARINE AQUACULTURE: BIOLOGY OF TWO CLONAL STRAINS

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Mangrove killifish, *Rivulus marmoratus* (Family Rivulidae) is unique among vertebrates because it is the only synchronously self-fertilizing (produce clones) vertebrate. Moreover, they are easy to rear and handle because of their wide tolerance to harsh environment, and they are highly sensitive to chemicals. Because of these features, they have been widely used in population genetics, carcinogenicity, and toxicity studies and we are trying to develop this species as a model for marine aquaculture. However, little is known about the biology of this species. The objective of this study was to characterize and compare the life-history traits, such as reproductive traits, morphology, physiology and feeding behavior in two strains (PAN-RS and DAN). . Larvae and juveniles were reared in 60 ml plastic cups (25 ±1°C; 17 ppt; 14L:10D) and fed with *Artemia franciscana* every two days (480 inds/cup). Adult fish (> 5 months) were reared in recirculating system under the same conditions and were fed with pellets until satiation. Fecundity, age at sexual maturity, and embryonic period was based on individual record of fish. Sex ratio (hermaphrodite:primary male) was determined by histological analysis of 196 gonads (166 PAN-RS and 30 DAN). Reproductive cycle (spawning and ovulation) was observed at 3 hours interval for 7 days in 11 PAN-RS and 4 DAN (7-8 months old). Growth, morphometry, and meristic features were measured in 65 fish from each strain from 0 to 100 days after hatching (DAH). Activities of digestive enzymes (trypsin, alkaline phosphatase, and esterase) were assayed from 0 to 138 DAH. Feeding behavior from 0 to 60 DAH was analyzed by video camera.

Fecundity was significantly higher in PAN-RS than DAN. Sex ratio was significantly different, with DAN producing more primary males than PAN-RS. PAN-RS showed significantly higher growth than DAN from 0 to 100 DAH. Ossification and meristic counts indicated that this species becomes juvenile at 9.8 mm SL. Spawning and ovulation cycle did not clearly differ between strains. The difference between digestive enzyme activities was weak, however, feed intake of DAN was significantly higher than PAN-RS. Age at sexual maturity, embryonic period, morphometric, and meristic characters (vertebral and fin-ray counts) did not differ between strains.

A positive relationship between growth and reproductive effort was found. High fecundity in PAN-RS may allow increasing chance of offspring survival, while the attainment of sexual maturity at a smaller size in DAN may be a strategy to invest earlier in reproduction to increase breeding success. Variations in characters in the two clonal strains may be related with survival and reproductive success (fitness). This may be an adaptive strategy to suit in the natural habitat, the mangrove estuaries with a highly variable environment. These variations in life-history traits in two clonal strains may be mediated by physiological and/or behavioral mechanisms. Enzyme activities between strains did not differ, however, feed intake was significantly higher in the strain with lower growth (DAN). This suggests that variations may be due to other factors such as metabolic activities and other physiological mechan305, Marvel Mansionisms.

SOME ASPECTS OF THE BIOLOGY AND CONSERVATION OF *Horabagrus brachysoma* AN ENDANGERED BAGRID CATFISH FROM VEMBANAD LAKE, INDIA

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Horabagrus brachysoma, an important bagrid catfish that is endemic to the rivers and backwaters of South India has been facing severe ecological threats and anthropogenic pressures in their natural habitats and is listed as an endangered species. In this paper, we report the result of our studies on aspects of the biology of this endangered catfish from the Vembanad Lake in Kerala State, India. The length-weight relationship of *H. brachysoma* collected from the lake eco-system revealed an acute negative isometric growth pattern with "b" values being 1.7616 for males and 1.9441 for females. *H. brachysoma* was found to be an omnivorous feeder with marked preferences for crustaceans, fishes and/or their larvae. The feeding behaviour was observed to be influenced by several factors including age, maturity stages and the ecological characteristics of the habitat it frequents. Reproduction was found to be seasonal and confluent with the monsoon months of June-August. The minimum size at first maturity for females was found to be about 210mm. The fecundity of this species ranged from 1600 to 18,300. The first reported study on the biology of *H. brachysoma* from the Vembanad Lake in South India has greatly enhanced our understanding of the species and has formed a preliminary database upon which future studies on its aquaculture potential can be modeled upon. The major threats to the survival and reproduction of this species in their natural habitats have been discussed. Suitable strategies for conservation and management of this endangered catfish in the fluvial and lentic ecosystems of South India are also presented.

PRELIMINARY BIOLOGY STUDY OF THAI TUNICATE *Ecteinascidia thurstoni* FOR AQUACULTURE

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Recently in Thailand, a colonial tunicate, which was identified as *Ecteinascidia thurstoni* Herdman, 1891, has been discovered. This tunicate can produce chemicals called Ecteinascidin (Et) such as Et 770 and Et 786, which displayed potent cytotoxic activity against cancer cells of breast, lung, colorectal, and nasopharynx. Therefore, as a potential drug resource in the future, the knowledge on biology of this tunicate is needed for aquaculture. In this study, we investigated the life cycle and development of *E. thurstoni* both in the natural habitat and in the culture system. The stomach content of the tunicate was also analyzed to determine food preference. The results showed that *E. thurstoni* has a life span of approximately 40 days. In the natural habitat, the highest density and abundance of is in February, June, and October each year. In addition, in the laboratory, we were able to induce tadpoles to attach on settlement plates and develop into the juvenile stage. The details are discussed in the paper.

THE DISTRIBUTION OF ECHINODERMATA AT MUSSEL CULTURE AREA IN SEBATU, MALACCA

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The association of Echinoderm and mussel (*Perna viridis*) were studied from April to November, 2002. The objectives of the study were to determine the distribution of echinoderm on the mussels cultivation rope and their abundance according to time of culture. Cultivation rope 1 m length was divided into three sections, top (0.0 – 0.33 m), middle (0.34 – 0.66 m) and (0.67 – 1.0 m). Echinoderms from mussel cultivation ropes aged less than one month, three months and more than 6 month were collected manually by hand and counted. Densities of Echinoderms were high on middle and bottom section of cultivation ropes. Ropes less than 1 month have more Echinoderms with 25 ± 1.13 ind./rope, followed by ropes more than six months (18 ± 1.20) ind./rope) and the lowest was on 3 months old culture ropes (12 ± 0.51 ind./rope). The size of Echinoderms also varies according to the age of ropes.

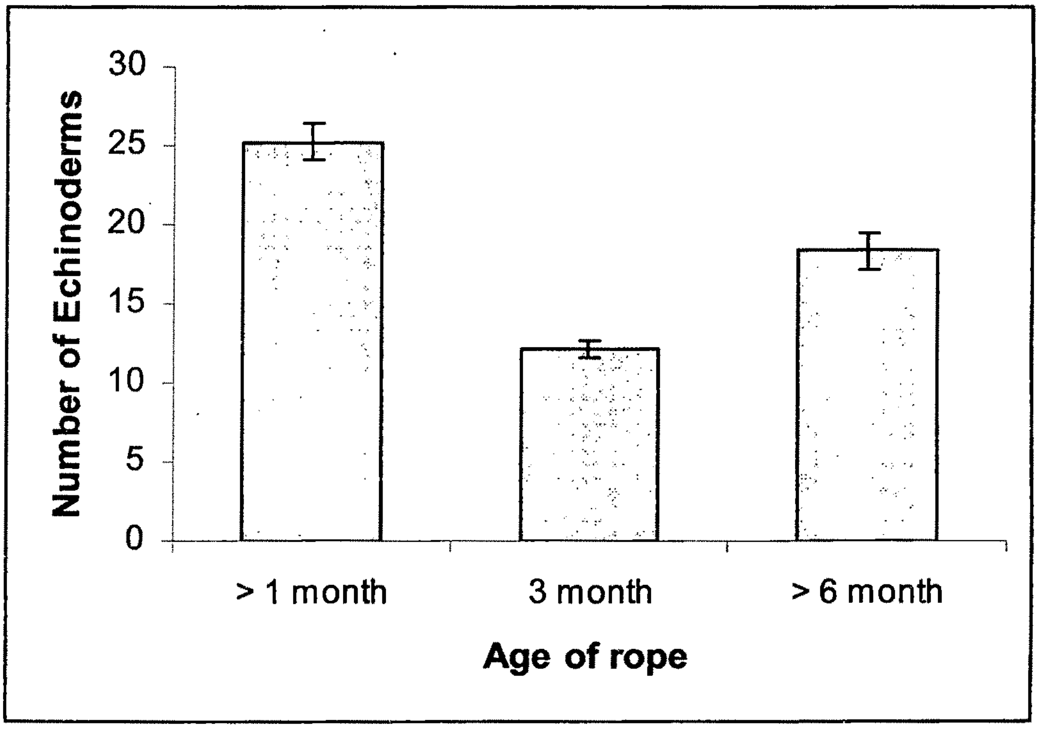

Figure 1. The distribution of echinoderms on the cultivation rope aged less than month, 3 month and more than 6 month.

SEASONAL CHANGES IN *Perkinsus* AND *Cercaria* INFECTIONS IN THE MANILA CLAM *Ruditapes philippinarum* FROM JEJU, KOREA

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Seasonal changes in the infection intensity of *Perkinsus* and *Cercaria* were investigated in Manila clams *Ruditapes philippinarum* collected from a sand beach on the east coast of Jeju, Korea. *Perkinsus* prevalence and infection intensity were determined from histological preparations of clams. The prevalence varied seasonally: it was lowest in late September 2001 (6.0%) and highest in March 2002 (86.0%), with an annual mean of 32.9%. Monthly mean infection intensity of *Perkinsus* varied from 0.11 (September 2001) to 2.08 (March 2002), with a mean of 0.63. Tissue inflammation caused by massive hemocyte infiltration was commonly observed in the gills of heavy infected clams. Degenerated oocytes and castrated follicles were observed in clams that were severely infected with *Cercaria* during the spawning period, indicating that *Cercaria* interferes with the reproductive process of clams. The prevalence of *Cercaria* was highest in early August (12.0%), while none of the infected clams were observed in several months. Although *Perkinsus* and *Cercaria* related clam mortalities were not observed in this study, the histological findings clearly show that the parasitism impacts clam reproduction, at least during part of the annual reproductive cycle.

ECHINODERM ASSOCIATED WITH CULTURED MUSSEL

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A study of Echinoderm species was conducted in Sebatu, Malacca (2° 05.98 North and 102° 28.09 East) from April to November, 2002. The objective of the study was to identify the species of echinoderm that associated with mussel in the cultured area. Echinoderm was collected manually from mussel ropes. Results showed that six species from three different classes of Echinoderms were found on the mussel cultivation ropes: 51% of Ophiuroidea, 41% of Echinoidea and 8% of Holothuroidea (figure 1). Two species of Ophiroidea (*Ophiactis* sp. and *Ophiocoma wendti*), one species of Echinoidea (*Temnopleuros toreumaticus*) and 3 species of Holothuroidea (*Stolus buccalis*, *Hemithyone semperi* and *Actinocucumis* sp.) were identified. The water parameter such as salinity, temperature and dissolved oxygen were not significantly different between months of sampling.

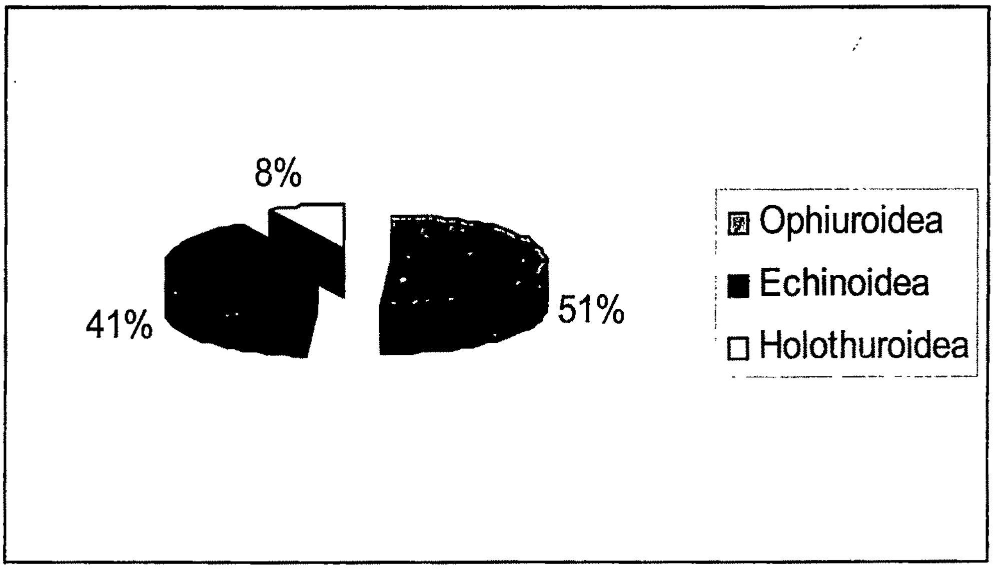

Figure 1 Percentages of Echinoderm that associated with mussel

OCCURRENCE OF PARASITES, ESPECIALLY *Marteilioides chungmuensis* IN PACIFIC OYSTERS, *Crassostrea gigas*

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The occurrence of parasites was surveyed in Pacific oysters, *Crassostrea gigas* from several coastal areas of Korea. Protozoan includes gregarine-like organism, *Marteilioides chungmuensis, Haplosporidium;* ciliates *Ancitrocoma* and Metazoa (trematode, nematode, copepod) were observed in oysters from most of the sampling areas. *Marteilioides chungmuensis* and *Gymnophalloides sp.* were frequently found in all sampling sites. The prevalence and infection intensity of the ovarian parasite *M. chungmuensis* during an annual reproductive cycle of oysters was observed in Gosung Bay. *Marteilioides chungmuensis* occurred in developing and fully mature eggs of spawning oysters in late June to January, but were not observed from February to May. Monthly mean infection intensity was high in late June, late August and November, when most oysters were spawning or had complete spawning. Several oysters collected in November and December carried a large numbers of *M. chungmuensis*-infected eggs, suggesting that infection causes spawning failure by delaying spawning and destroying ripe oocytes.

HAEMATOLOGICAL RESPONSE IN ECOPHYSIOLOGICAL ADAPTATIONS IN SOME FRESH WATER FISHES-CONCEPT OF ADAPTATIONAL ANAEMIA

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Haematological data on *Heteropneustes fossilis, Anabas testudineus, Macrognathus aculeatum* and *Mystus vittatus* were examined and statistically evaluated to -(a) study the pattern of changes in blood parameters in relation to ecophysiological conditions (b) determine, if any significant correlation exists amongst certain blood parameters (c) assess whether or not there is uniformity of pattern and generalization is possible, and (d) assess the applicability of haematological criteria for diagnosis of health. Living in the same pond does not confer any uniformity of pattern in the haematological parameters of fresh-water fishes. Haematological response of each species to changes in the environmental parameters and physiological demand is distinct and it depends upon the ecological conditions and respiratory efficiency. All species exhibit an adaptational 'winter pseudoanaemia' in the form of reduced RBC number and Hb concentration relative to the annual mean values. The significance of haematological variations in relation to respiratory efficiency is discussed and the use of haematological criteria for the assessment of the state of health of cultivable fish species emphasized.

TABLE1. Showing relationships of some haematological parameters in four species of teleosts.

Parameters / Name of the Fish	RBC/ Hb	RBC/ MCV	RBC/ MCH	CVI/ CI	Day Length/ RBC	Day Length/ Hb	Temp/ RBC	Temp/ Hb	Annual peak
H. fossilis	+S	-S	-S	+S	+S	+S	+S	+S	1
A. testudineus	+S	NS	-S	No co-relation	NS	NS	NS	NS	2
M. aculeatum	NS	+S	NS	+S	NS	NS	NS	NS	2
M. vittatus	+S	-S	-S	+S	+S	+S	+S	+S	1

+ = Positive correlation; - = Negative correlation; S = Significant (P=0.01). NS = Non Significant

TABLE 2. Showing blood condition of blood cells (RBC) in winter and summer months in four species of teleosts. Cytic=RBC cell size; Chromic=Concentration of Hb in RBC.

Name of the Fish	Winter month	Summer months
H. fossilis	Macrocytic and Hyperchromic	Microcytic and Hypochromic
A. testudineus	Macrocytic and Hyperchromic	Macrocytic and Normo or Hyperchromic
M. aculeatum	Macrocytic and Hypochromic	Macrocytic and Hyperchromic
M. vittatus	Macrocytic and Normo or Hyper chromic	Microcytic and Hypochromic

GROWTH AND PRODUCTION OF LABORATORY CULTURED CYCLOPOID COPEPOD *Apocyclops dengizicus* (LEPESCHKIN, 1900) AT DIFFERENT SALINITY LEVELS

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Species of cyclopoid copepod *Apocyclops* are known to inhabit brackish coastal lagoons, salt marshes and inland saline lakes in arid continental regions, where they are often the recorded dominant zooplankton. Members of *Apocyclops* are easily cultured, e.g., on marine yeast, green algae, or mixture of *Paramecium caudatum* and *Chilomonas*. The objective of this study is to determine the tolerance of laboratory cultured *A. dengizicus* to different levels of salinity.

Copepod samples composed of *Apocyclops* were collected from the coastal waters of Port Dickson in June 2003. A berried individual of *A. dengizicus* was isolated from the water samples and maintained in natural filtered autoclaved sea water (salinity 28 ppt) for reproduction and growth. Eight different salinity concentrations, i.e. 0, 5, 10, 15, 20, 25, 30, and 35 ppt were prepared by diluting and concentrating the natural sea water.

Results showed that *A. dengizicus* cultured at different salinities (5-35 ppt) contained individuals of all life history stages (nauplii, copepodites, males, females, and gravid females) throughout the 20-day experiment period. Density of *A. dengizicus* was however low (~ 3 ind./ml) in salinity less than 10 ppt and higher than 30 ppt. Although different copepod growth rates and densities were observed during the experiment, mating only successfully took place in salinity ranging from 5-35 ppt. Nauplii numbers ranged from 21.78 ± 1.76 to 85.83 ± 7.90 per gravid female in its life time.

The nauplii production per gravid females decreased with age and the first five clutches of gravids were better in term of quality and quantity of offsprings produced. This study illustrated that salinity levels from 15 to 25 ppt were the most suitable for culture of *A.dengizicus*. At these levels, *A. dengizicus* showed maximum density (~280-535 ind./gravid female), maximum survival rate (70-90%), and the highest longevity (45-65 day).

ASSESSMENT OF FISH FAUNA IN BEEL KHUKSHIA OF JESSORE, BANGLADESH

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Biodiversity of fish in *beels* (natural depressions) has been impacted because of high population pressure, over exploitation and indiscriminate use of fine meshed fishing gears. Additionally, effects of extensive flood control and irrigation activities have reduced the fish biodiversity and fish yield in many beels due to siltation, habitat destruction, macrophyte infestation and isolation from the seasonal floods restricting entry of riverine fish stocks including impact of stocking enhancement. Considering the importance of biodiversity for sustainable management of natural resources, the present study was conducted to assess the fish and prawn biodiversity in Beel Khukshia for 20 months from November 2002 to June 2004. Beel Khukshia is located in Jessore district in southwest Bangladesh. It is a semi-closed beel with brackish water influence and is surrounded by earthen dyke at one side of the beel. Water depth of the beel varies between 0.5 and 3.1 m, while that of canal varies between 3.0 and 5.0 m and the maximum water depth of Beel Khukshia canal during rainy season is 16 meter. A total of 63 species of fish and prawns belonging to 9 orders, 28 families and 47 genera were recorded from the beel, out of which 59 were fish species (56 indigenous and 3 exotic species) and remaining 4 were prawn. The fish groups were dominated by Cyprinidae with twelve species (including the exotic one) followed by Bagridae (6 species) and Channidae (4 species).

A total of 33 species of resident, 14 species of riverine and 13 species of migratory fishes formed the indigenous fish community. Minnows and carps was the richest among the common groups and dominated by *Puntius sophore* and *P. ticto*. Predator fish comprising 26 species was a major component of trophic groups in fishers' catch. In respect number of species, major contribution was by bottom feeders (31 species) closely followed by surface feeders (28 species) and column feeders (4 species). *P. sophore* was the major species in the fishers' catch in terms of quantitative abundance followed by *Macrobrachium* spp., *Metapanaeus monoceros*, *Mystus tengra*, *Glossogobius giuris*, *Mystus vittatus*, *Channa punctata* and *Macrognathus puncalus*. Results of the present study indicated that small fish and prawn species form major portion of capture fisheries in Beel Khukshia. The results of this study are expected to provide baseline information on biodiversity for eventual sustainable management of beel resources.

STUDY ON PATERNAL GERMPLASM REPOSITORY OF SELECTED INDIGENOUS FRESHWATER FISHES IN TAIWAN

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This study aimed to investigate the biological characteristics and to establish the cryopreservation protocol for sperm of selected indigenous freshwater fishes. In recent years, seven major indigenous freshwater fishes: (1) *Zacco pachycephalus,* (2) *Spinibarbus hollandi,* (3) *Macropodus opercularis,* (4) *Varicorhinus barbatulus,* (5) *Candidia barbata,* (6) *Distoechodon tumirostris, and* (7) *Acrossocheilus paradoxus,* were selected. Sperm from these fishes was collected by squeezing after anaesthetization, except for *M. opercularis* with very limited quantity of sperm. In this case, the experimental fish was chilled and testes was dissected and ground for sperm extraction. Injection of pituitary gland and hormones (LHRH and Gonadotropin) was applied to promote maturation of spawners when necessary. Biological characteristics of the sperm and milt such as morphology, osmotic pressure and pH values were assessed. Sperm concentration was counted using flow cytometry,. Sperm toxicity tolerance to cryoportectants (CPAs) including DMSO, glycerol and methanol was also determined. Results show that the higher the concentration of the CPAs, the lower was the sperm motility of these fishes.

Favorable cryopreservation strategies were also established for each species, using three designed protocols for freshwater fish sperm, FW1, FW2, and FW3 and three CPAs, DMSO, glycerol, and methanol. Examination of frozen-thawed sperm motility indicated that in the case of *Z. pachycephalus*, either one of three CPAs at the concentration of 15% showed better motility than those at lower concentrations, especially in FW3. For *S. hollandi*, the best result was obtained in 15% DMSO using FW1, while no motile sperm was obtained with 5, 10, or 15% methanol. For *M. opercularis*, 5% DMSO was found the most efficient and FW2 was better than other two freezing protocols. Cryopreservation in 10% glycerol resulted in best motility after thawing. In *S. barbatulus,* DMSO with protocol FW2 gave the best result, while in *C. barbata*, 10 and 15% DMSO with FW3 resulted in the best frozen-thawed motility, superior to others. *D. tumirostris* and *A. paradoxus* sperms showed good performance in10 and 15% DMSO compared to other CPAs. However, 15% glycerol combined with FW1 and FW3 resulted in the best frozen-thawed motility in *A. paradoxus*.
This study showed the feasibility for cryopreserving sperm of the selected indigenous freshwater fishes in Taiwan. The optimal protocol for respective species should be followed to achieve the best performance of preserved sperm.

STUDY ON PIVOTAL TEMPERATURE OF GREEN TURTLE *Chelonia mydas* ON THE EAST COAST OF PENINSULAR MALAYSIA

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Green turtle (*Chelonia mydas*) is a major species of sea turtles landed and nested in Malaysia as well as in the Southeast Asian region. This study was undertaken during 1997 to 1998 in Mak Kepit at Redang Island in Terengganu and Chendor in Pahang in Malaysia. The objectives of the study were to determine the optimum temperature that could result in best hatching performance and to assess suitable incubation temperatures for producing male and female hatchlings as hatching and sex is determined mainly by egg incubation temperatures. .

The results indicated that temperatures of 27.2- 29.2°C produce more male turtle hatchlings at the Mak Kepit rookeries, while female hatchlings are dominant at temperatures 29.5 °C. At temperatures of 32.0 - 34.0°C 100 % female hatchlings are produced. This study also revealed that at Chendor, temperatures of 27.2 - 29.0°C produce more male hatchlings while female hatchlings are dominant at incubation temperatures above 29.5 °C. At temperatures between 32.0 - 33.0°C 100 % female hatchlings are produced. Determination of pivotal temperature is vital for successful hatchery management of sea turtles in Malaysia as well as in the Southeast Asian region.

Table 1 **Sex of turtle eggs hatched at at different temperatures at Mak Kepit rookeries in 1997.**

Temperature	MK1			MK2			MK3			Total			%		
°C	M	F	I	M	F	I	M	F	I	M	F	I	M	F	I
30	1	5	0	4	2	0	2	4	0	7	11	0	39	61	0
31	0	10	0	0	6	0	1	6	0	1	22	0	4	96	0
32	0	10	0	0	8	0	0	7	0	0	25	0	0	100	0
33	0	6	0	0	6	0	0	6	0	0	18	0	0	100	0
34	0	0	0	0	5	0	0	0	0	0	5	0	0	100	0

Table 2 **Sex of turtle eggs hatched at different temperatures at Mak Kepit rookeries in 1998**

Temperature	MK1			MK2			MK3			Total			%		
°C	M	F	I	M	F	I	M	F	I	M	F	I	M	F	I
27.2	10	0	0	0	0	0	9	0	0	19	0	0	100	0	0
27.7	6	2	2	10	0	0	0	0	0	16	2	2	80	10	10
28.0	8	2	0	0	0	0	7	1	1	15	3	1	79	16	5
28.2	7	3	0	0	0	0	0	0	0	7	3	0	70	30	0
28.7	3	6	0	0	0	0	8	0	0	11	6	0	65	35	0
29.0	6	4	0	10	0	0	4	5	0	20	9	0	69	31	0
29.2	8	2	0	10	0	0	6	3	0	24	5	0	83	17	0
29.5	1	6	2	4	2	0	3	3	0	8	11	2	38	52	10
29.7	1	9	0	2	6	2	3	3	0	6	18	2	23	69	8

M = male, F = female and I = intersex

TWO SPECIES OF HORSESHOE CRABS, THE *Carcinoscorpius rotundicauda* AND *Tachypleus gigas* IN PENINSULAR MALAYSIA

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The horseshoe crab was named such owing to its horseshoe-shaped carapace. Its local names vary from "Belangkas" to "Kuncung". According to literature, it is considered as a living fossil of about 500 million years old. As of now, there are only four living species of horseshoe crabs, the *Limulus polyphemus, Carcinoscorpius rotundicauda, Tachypleus tridentatus* and *Tachypleus gigas.*

At present, there is an indication of declining population of horseshoe crab in Peninsular Malaysia. Found in abundance in some coastal areas (Perak, Selangor and Johor) of Peninsular Malaysia, some ten to fifteen years ago. It is believe that due to over harvesting, this invertebrate can only be found coming to shore in very few locations. Thus, this study was carried out with the purpose to identify the species, areas and when (month) horseshoe crab can be found.

Survey on the distribution of horseshoe crab in Peninsular Malaysia was carried out from November 2003 to August 2004. These areas included coastal areas of Perlis (Sanglang), Kedah (Kuala Kedah), Penang (Bukit Tambun), Perak (Tg. Kepah), Selangor (Kuala Selangor, Pulau Indah, Pulau Carey, Bagan Lalang), Negeri Sembilan (Port Dickson), Johor (Minyak Beku, Pontian Kecil, Tg. Sedili, Tg. Adang, Kukup, Kg. Kong Kong, Desaru), Pahang (Pantai Baloh, Kg. Cherating Lama, Sg. Bebar), Trengganu (Tg. Jara, Marang, Paka, Penarek) and Kelantan (Pantai Seri Tujuh, Pantai Bisikan Bayu, Tok Bali, Kuala Besar). The survey was carried out for a period of 5 to 6 days, spanning the duration of full moon and high tide that coincides with the time when the horseshoe crab land on shores for spawning. Following the morphological descriptions by Sekiguchi (1988) and Chiu and Morton (2003), two species were identified, the *Carcinoscorpius rotundicauda* and *Tachypleus gigas*. Survey showed that *T. gigas* can be found in 23 locations, while *C. rotundicauda* only in 3 locations. Interviews with fishermen indicated that the horseshoe population in Peninsular Malaysia is declining rapidly due over harvesting by fishermen to supply to local and oversea market (Thailand). Maybe many people are unaware that this species takes about 9 years to be able to reproduce and with this length of time required for it to reach maturity, it will not be easy to replenish the stock. Therefore conservation of the species should be look into before it is too late.

MIGRATION AND BREEDING OF FRESHWATER FISHES IN THE BEELS OF EASTER BANGLADESH

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To promote sustainable use of open water fisheries resources through commun management, the WorldFish Center has been implementing a project (CBFM-2) in 115 op water bodies of Bangladesh in collaboration with the Department of Fisheries (DoF Government of Bangladesh and a number of Non-Government Organizations. Among t 115 beels, three beels *viz.*, Shakla, Hurul and Shapla located in Brahmanbaria we selected to carry out the present study. The main focus of the study is to gather informati on the migration and breeding of beel fishes for conservation and sustainable production.

The study so far revealed that four types of migration are undertaken by fish species in t region *viz.*, (i) spawning migration (pre-monsoon and early monsoon)- sexually ripe adu swim to spawning localities, (ii) nursing migrations (early monsoon and monsoon)- larv and fingerlings move (passively and actively) to nursery grounds to begin growth, (Feeding migration (monsoon)- juvenile and adult fish (once breeding is completed) migra to feeding grounds, (iv) refuge migration (late monsoon and early dry season)-juvenile a adult fish migrate to dry season refuge grounds. Hydrological conditions of the beels revealed by earlier studies have strong influence on migration and breeding of beel fishe On the basis of this, the hydrological conditions of the beels are categorized into t following types:

- Pre-monsoon river flood surge and recession
- Early monsoon river flood surge
- Sustained monsoon beel flooding
- Late monsoon beel drainage
- Dry season fish refuge habitat area contraction
- Un-seasonal beel inundation from local rainfall during dry season

When water temperature increases during the pre-monsoon flood surge period, almost the fish species in this region are under the process of sexual maturation and innate fi migration behaviour is synchronized for breeding activity and most of the fishes were fou with ripe or ripening gonads. A strong pre-monsoon flood surge might trigger a larg spawning migration than a weak surge. However, as yet, there has been limited knowled of migration patterns for many species in this region. Some reproductive characteristics selected beel fishes *viz.* breeding season, frequency of breeding, spawning type, pattern migration and breeding substrate (nest type) were also identified during the present stud Further investigation is needed to know precisely the floodplain breeding species, the spawning season and required environmental cues for migration and breeding, as well.

THREATENED FISHES OF RIVERS OF KERALA (SOUTH INDIA) WITH SPECIAL REFERENCE TO ENDEMISM, DISTRIBUTION AND STOCK SIZE

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The rivers and streams originating from the Western ghats of Kerala, India are considered to be hotspots of exceptional fish biodiversity owing to their unique freshwater fish wealth. 170 fresh water fishes have been so far reported from the diverse riverine systems of Kerala. A recent survey and sampling conducted in 21 river systems of Kerala revealed the presence of 143 fish species of which 75 species were potential ornamental, 44 food fishes and 21 fishes were cultivable. The distribution pattern of the fishes in 21 major river systems of Kerala has been studied. The biodiversity status of the fishes delineated were assessed based on the IUCN criteria, which revealed the presence of 12 critically endangered species and 25 endangered 12 vulnerable. The threatened fishes were showing high habitat specificity and endemism. The distribution of these fishes are restricted to a few locations only. Among the critically endangered, 9 species were restricted to a single locality of a single river system and 3 species are distributed in single locations of two river systems. Ten species under this category are found strictly endemic to Western ghats of Kerala alone. Among the 25 species coming under endangered category, 12 species such as *Cirrhinus reba* and *Glyptothorax lonah* were found in a single river system and 12 species found restricted to 2 rivers. Among the 12 vulnerable species, *Gonoproktopterus dubius* was found in Kabbini river system alone where as 5 species, are distributed in 2 river systems and 5 species are found in three river systems. Fishes in the upstreams have several morphological adaptations to withstand the extreme habitat conditions at the high ranges. The abundance of threatened fishes in different river systems of Kerala were found out based on catch/hr. values. The catch/hr values for critically endangered species such as *Balitora mysorensis* (0.01kg), *Mystus bleekeri* (0.0124kg) were found extremely low and maximum for *Lepidopygopsis typus* (0.522kg) and *G.micropogon periyarensis* (0.355kg). For *Channa micropeltes* it was 0.05Kg and for *Crossochelus periyarensis* it was 0.099Kg. Among endangered species, abundance of *Glyptothorax lonah* (0.01kg) and *Travancoria jonesi* (0.001kg) were found very low as indicated by their low catch/hr. and the abundance was maximum for *Neolissochilus wynaadensis* (0.24kg). For species such as *Cirrhinus reba* it was 0.07kg, *Osteochilichthys nashii* 0.123kg, *O.longidorsalis* 0.092kg, *Barilius bendelisis* 0.02kg and *Garra hughi* 0.014kg. Vulnerable species such *Nemacheilus monilis* (0.001kg) and *N. semiarmatus* (0.0024kg) had minimum catch/hr and species such as *Osteobrama bakeri* (0.214kg) and *Notopterus notopterus* (0.241kg), had the maximum. For species such as *Puntius conchonius, Sicyopterus griseus* and *Glyptothorax annandalie* it was 0.004kg, 0.0047kg and 0.0241kg respectively. The abundance of most of the species are depleting at a fast rate due to diverse types of human interventions and habitat destructions.

CONSERVING ASIAN BIODIVERSITY: IMPOSSIBLE WITHOUT INFORMATION SYSTEMS?

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Asia is a global center of aquatic biodiversity, especially marine biodiversity. It is also a region that is heavily and increasingly dependent on aquatic living resources for food, employment, social security, and external trade. Intensive attempts to boost aquatic production have also resulted in the introduction of a number of species for aquaculture, some of which have become invasive, and others possible pathways for introduction of pathogens into Asia. The monitoring of these movements between and within countries places a growing stress on national human capacity. The distribution of living aquatic resources along river courses, lakes, coastlines, islands and in the open ocean also presents enormous challenges for management and conservation. This is further amplified by the overlapping jurisdiction in the distribution of important fish stocks, the cultural and language diversity in the region, and extensive spread and relative isolation of dependent communities. Not least of all is the challenge of acquiring quality information on a large number of species, ecosystems, habitats, and methodologies to undertake conservation efforts often in data-poor situations.

Management planning and interventions have been pursued particularly in coastal zones through a variety of mechanisms using governmental and non-governmental, local government and community-based approaches. Transaction costs remain however high, as communication, information dissemination, and capacity-strengthening depend largely on traditional extension systems, workshop-intensive interactions, and high cost of media. These are often repetitive, vary in quality of delivery, and dependent on significant funding.

The opportunity exists for building an information technology foundation across Asia that can simultaneously address many of these constraints cost-effectively: by providing constantly available multi-lingual knowledge, manage masses of data, develop conservation tools, and provide consistent and expertly verified decision support. This capability can be made available at various geographic scales and focused on a diversity of aquatic bodies. Opportunities exist for leveraging the capacity of the internet, mobile and hand-held computing to reach remote locations, to connect and exchange experiences between many aquatic-dependent communities, and to deliver high quality support. Attempting this through traditional means would require prohibitive expenditure, and be limited by logistical realities.

It is arguable that without the application of such information system solutions, pockets of aquatic biodiversity may be conserved through traditional means, however benefiting other areas with this experience and laying the foundation for country and region-wide improvements against a regional trend of biodiversity destruction, are practically impossible. Examples are presented of information system approaches that are immediately applicable to significantly benefit aquatic biodiversity conservation in Asia on a region-wide scale.

CONSERVATION OF SMALL INDIGENOUS SPECIES (SIS) IN FLOOD-PLAIN ECOSYSTEM, BANGLADESH

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Bangladesh is a country with huge water resources. Inland aquaculture together with coastal shrimp culture accounts for 40% of the total production while the inland open water fisheries contribute 40%. In recent years, natural stocks of flood-plain dwelling small fishes including carps have declined because of deterioration of aquatic habitats caused mainly from over-exploitation, removal of water for irrigation, siltation and soil erosion, reclamation of land for settlement, pollution, etc. IUCN Bangladesh has documented about 56 freshwater fish species critically endangered.

Present study was undertaken to conserve Small Indigenous Species (SIS) by creating sanctuary and by stocking the beel with Self Recruiting Species (SRS) to enhance their population and diversity. There were also other aims to see how the project has induced the social interaction, to assess the community contribution and if there are any disputes among the stakeholders. Present study has contributed a lot in guiding how to increase population density of SIS in the beel; to make available SIS fry and brood among the beel fishers; to meet nutritional deficiency and to increase income for ameliorating their livelihood. This study successfully developed gender policy through involving the stakeholders and equity basis profit sharing for the different stake-holders in the flood-plain area.

ESTIMATED ECONOMIC VALUE OF HAIL HAOR AND ESTIMATION IN A WETLAND IN MALIJHEE FLOODPLAIN FOR BENEFIT OF RESOURCE MANAGERS AND COMMUNITY

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All wetlands especially in the context of Bangladesh have tremendous direct and indirect value for the livelihoods of the poor, and immense value for maintaining sustainable aquatic environment. Fish, paddy, navigation, aquatic weeds, tourism/aesthetic values to some extent are directly dependent on wetlands. Ignoring the economic value of the wetlands and beels/floodplains, most developmental activities and interventions have been focussing on a single 'tunnel" focussed objective. This has rather contradicted the concept of integrated development and damaged the environment on which livelihood of poor people depends.

Policy makers due to lack of proper knowledge of economic value of wetlands and due to ignorance to some extent allow interventions often destructive to wetlands. Thus for the planners, decision makers and managers an information base on economic value of wetlands is essential. Unfortunately, limited studies have been conducted on this aspect.

Main purpose of the study was to develop and strengthen information base for wetland value to support planning and integrated management and research. As part of the methodology an excel based bio-economic model or Resource Valuation Model (RVM) associated with Poverty Assessment Model (PAM) has been used for the study.
For estimation of economic value or benefits, a variety of approaches and information collection steps were taken e.g., household survey, RRA, PRA. Existing MACH CNRS catch data was used for fish production/value estimation. Remote sensing output was used to estimate pasture value. Values estimated for fisheries, non-fish products, recreation, flood control, vegetation, transportation, navigation, pasture, irrigated rice, surface and ground water use for irrigation, water quality, groundwater recharge and others. It was found that poor people of chronic deficient, occasional deficient and break-even point are major users of wetland products. Many of these common property resources in the wetlands play significant role in the income, livelihood and survival of poor people. It is estimated that the value of wetland/resources is about US$ 300/ha/year where rice is not contributing major share. Thus further draining of wetlands for irrigated crop cultivation should not be encouraged rather wetlands should be protected for the benefit of poor people for their livelihood, food security and also for protecting aquatic environment.

The study was supported by SUFER (Support for University Fisheries Education and Research) a project of University Grant Commission and DFID, USAID supported MACH (Management of Aquatic Resources through Community Husbandry) and executed by investigators from TARA and Dhaka University. The study sites covered eight beels/canals and eight surrounding villages in Sherpur District, Bangladesh.

INTEGRATING FISH FARMING WITH MAKHANA *Eurale ferox*

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Among the various food production systems, aquaculture is widely perceived as an important activity in the global fight against malnutrition and poverty. As an important domestic provider of much needed high quality animal protein and other essential nutrients, it plays an important role in the development of national economy and it contributes significantly to rural development. For an optional and judicious management of water resources, both political (including administrative) and scientific measures need to be considered. It is only through a concerted effort and planned approach, coupled with fishermen awareness and participation, that a rational strategy can be adopted to utilize the water resources efficiently for human food, health and welfare.

Makhana cultivation is widely practiced in swampy areas of Bihar especially in the North Bihar region, which covers more than 2000 ha. These areas are heavily silted with about 0.5 ha shallow water bodies with a water depth ranging from 0.6 m to 1.20 m throughout the year. It is a perennial water body which is regularly being utilized for makhana cultivation.

The various stages of Makhana cultivation in ponds and tanks considerably alter as well as disrupt the ecological condition of the water body. The planktonic productivity of such ponds remains very low due to shading of the surface by the makhana leaves. Consequently, the metabolic gases remain in totally unfavorable proportions which affect the production of ichthyofauna that are of economic importance. However, by proper management, the integration of fish culture with makhana farming can be successfully achieved, and offers greater efficiency in resource utilization and minimize crop loss risk by crop diversification. This also provides additional food and income to fishermen.

Table1. Integrated fish farming: Ecological niche in Makhana pond

Ecological niche	*Suitable species of carp for the niche*	*Zoological name*
Phytoplankton	Silver carp	*Hypophalmichthys molitrix* C & V
Zooplankton	Catla	*Catla catla* Ham
Periphyton	Rohu	*Labeo rohita* Ham.
Detritivore	Mrigal	*Cirrhinus mrigala* Ham.
Omnivore	Comman carp	*Cyprinus carpio* Linn.
Macrovegetation feeder	Grass carp	*Ctenopharyngodon* idella Val.

There are two distinct different methods of Integrated Makhana-Fish culture being adopted by fishermen. They are the Concurrent Makhana-Fish culture method and the Rotation of Makhana and Fish culture method. The design followed in Concurrent Makhana-Fish culture provides central vacant space or peripheral vacant space in the pond for proper breathing of fishes, where as in the rotation method the time of uncovered pond is utilized for fish growth. Makhana cultivation integrated with fish production is important for increasing profitability of fishermen.

INFLUENCE OF INDUSTRIAL POLLUTANTS ON THYROID AND INTER-RENAL FUNCTIONS IN THE FRESH WATER, AIR-BREATHING TELEOSTS *Channa punctatus* (BLOCH): EVIRONMENTAL IMPACT ANALYSIS

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Fresh water air breathing teleost, *Channa punctatus* (Bloch) was exposed to phenol, ammonia, mercuric chloride, cadmium chloride and mixture of the four for, l,2,15and 30 days to determine the short and long-term effects of sub-lethal doses of these industrial pollutants on the hypothalamo-pituitary-interrenal and the hypothalamo-pitutary-thyroid axes. The study demonstrated that in teleosts, pollutants influence thyroxine release mediated via the peroxidase system of iodination. Inhibition of head kidney peroxidase enzymes is usually associated with a decrease in iodide peroxidase activity and blood thyroxine level. Alterations in the head kidney acid phosphatase activity indicate changes in the lysosomal membrane characteristics caused by the pollutants. The stabilization of lysosomal membrane may account for a lowered head kidney lysosomal protease activity, which is essential for thyroxine release from the follicular cells of the head kidney. Guaiacol or non-iodide peroxidase is also active in head kidney of C. punctatus. An increase in guaiacol peroxidase activity was noted at certain periods of exposure to each of the pollutants and the mixture. This suggests that elevated guaiacol peroxidase activity have a role in the detoxification of industrial pollutants. The statistical tools like correlation coefficient among head kidney peroxidase enzymes and blood thyroxine level exhibited somewhat meaningful association. Strong positive correlation was observed between iodide peroxidase enzyme activity and blood thyroxine level due to exposure to cadmium chloride. Positive correlation was also noted between guaiacol peroxidase activity and blood thyroxine level due to exposure to mercuric chloride, ammonia and mixture of pollutants. Regression analysis displayed the directions and the magnitudes of changes in head kidney peroxidase enzymes and blood thyroxine level on days in linear form. Some of the parameters are positively related to days and some other being affected negatively. The estimated equation of iodide peroxidase enzyme activity on number of days is best fitted due to exposure to cadmium chloride; the rate of growth of iodide peroxidase with respect to days is 0.05. In case of thyroxine the impact of days is very much pronounced in positive direction under cadmium chloride, for mixture of pollutants it acts negatively as far as coefficient of estimated equation and R^2 are concerned.

Histopathological changes in the head kidney induced by the pollutants include dispersion of the inter-renal and chromaffin tissues, necrosis of the haemopoietic elements. The secretion of adrenocortical cells is chiefly concerned with the organism reaction to stress. The cellular damage in the inter-renal tissues due to exposure to industrial pollutants probably points to the lower production of cortisol with an overall decrease in the capacity of the fish to fight stress. The observations of haemopoietic tissues necrosis indicated reduced haemopoietic activity in fishes. Analysis of the available data suggest that the pollutants cause depletion of energy resources and disturb the metabolic pathway as indicated by the adverse effects on haematological parameter, enzyme system of head kidney, histopathological lesions in the head kidney.

BIOCHEMICAL RESPONSE OF THE ORANGE-SPOTTED GROUPER *Epinephelus coioides* TO SUSPENDED SEDIMENT

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Suspended sediment (SS) introduced by dredging and mud disposal activities is one of the major causes of fish mortality in fish culture farms in Hong Kong. This paper presents results of experiments designed to determine the toxic effects of SS on the orange-spotted grouper Epinephelus coioides, a species widely cultured by fish farmers in Hong Kong, Taiwan and southern China. Seabed sediment was collected from Port Shelter (PS), Tolo Harbour (TH) and Victoria Harbour (VH) in Hong Kong. Sediment from Victoria Harbour (VH) was heavily polluted by heavy metals, PCBs and PAHs. The collection sites in Tolo Harbour (TH) and Port Shelter (PS) are located near established fish culture zones and are comparatively less polluted than the collection site in Victoria Harbour (VH). Fish were exposed to seawater in outdoor tanks (100 L) containing SS from TH at 0, 8, 32 and 128 mgL-1 for 10 days and SS from all three sites at 0 and 128 mgL-1 for 30 days. Gill, liver and muscle of each fish were dissected at the end of experiments for measurement of aspartate aminotransferase (AST) and alanine aminotransferase (ALT) activities in liver, and creatine kinase activities in muscle and gill. Comet assay was conducted to evaluate DNA damage in liver cells.

ALT activity in liver was significantly higher in TH-8 mgL-1 and TH-32 mgL-1 than in control after 10 days. Surprisingly, ALT activity was slightly lower in TH-128 mgL-1 than in TH-8 mgL-1 and TH-32 mgL-1. The results pointed to the possibility of enzymatic suppression at the highest dose. There was no significant effect of SS on AST activity in liver and CK activities in muscle and gill after 10 days. Mortality rate in 30-day experiment was significantly higher in VH-128 mgL-1 than in control, TH-128 mgL-1 and PS-128 mgL-1. ALT activity was significantly lower in VH-128 mgL-1 than in TH-128 mgL-1 and PS-128 mgL-1. Because sediment from VH contained more pollutants than sediments from TH and PS, the results again pointed to the possibility of suppression of ALT activity at high pollutant level. CK activity in muscle was significantly higher in PS-128 mgL-1 than in control and the level of DNA damage was higher in TH-128 mgL-1 than in control. Our results confirmed that SS induced biochemical changes that could affect the health and compromise disease resistance in the orange-spotted grouper.

HISTOPATHOLOGICAL ALTERATIONS AS INDICATORS FOR EVALUATING THE SUBLETHAL EFFECTS OF SUSPENDED SEDIMENT ON THE ORANGE-SPOTTED GROUPER *Epinephelus coioides*

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Histopathological examinations are widely used to assess the effect of sublethal levels of environmental stress to living organisms. This presentation reports histopathological alterations in gill tissues of the orange-spotted grouper *Epinephelus coioides* exposed to suspended sediment (SS). *E. coioides* is an important food fish and mariculture species in Hong Kong, Taiwan and southern China. Seabed sediment was collected from Tolo Harbour (TH) and Victoria Harbour (VH), Hong Kong. The collection site in VH was heavily polluted by heavy metals, PCBs and PAHs. The collection site in TH was located near established mariculture zones and was relatively unpolluted. Exposure experiments were carried out in 100-L outdoor tanks and lasted up to 30 days. Seabed sediment was suspended using submersed pumps and air stones. Microscopic examinations revealed that the number of sediment particles on the gill filaments of *E. coioides* increased with SS concentration. Histopathological examination of gill tissues revealed that the incidence of abnormalities including lamellar aneurism, vascular congestion and dilation of lamellar capillaries was significantly higher in fish exposed to SS from VH at 128 mgL-1 than in fish exposed to SS from TH and control fish. Abnormalities such as epithelial lifting, hyperplasia of lamellar epithelia and fusion of the adjacent lamellae tended to be relatively uncommon and the frequency of occurrence did not appear to differ among treatment groups. These results were consistent with observations of increased frequency of gill ventilation and coughing in fish exposed to SS. In addition, the results showed that histopathological alterations provided useful indicators for assessing the sublethal effect of SS on marine fish.

STATUS OF MALAYSIAN CORAL REEF FISHERIES

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About 75 % of the 4,000 km^2 of coral reefs in Malaysia are found in Sabah and about 2,000 km^2 of reefs are protected by Sabah Parks (Pulau Tiga Marine Park, Tunku Abdul Rahman Park, Turtle Islands Park, and Tun Sakaran Park) and by the Sabah Wildlife Department (Sugud Islands Conservation Area) and the remaining reefs are open to fishing. The coral reefs in Peninsular Malaysia are now managed as fish sanctuaries under the Marine Protected Areas scheme of the Department of Fisheries, Malaysia.

This report is focused solely on coral reef fisheries of Sabah in literature from the 1970s to the present and from statistics gathered by the Department of Fisheries. Fisheries on coral reefs have not been given separate attention from demersal fisheries that includes trawl catches and from culture of other fishes (such as *Tilapia* spp. and *Lates calcarifer*). An attempt was made in 1996 to extract production of five reef-related families (Caesionidae, Labridae, Lethrinidae, Lutjanidae, Serranidae) from demersal fish statistics to get an estimate of its contribution and importance to the total marine fish production. It was estimated then that coral reef fisheries contributed about 7.26 to 22.63 % to marine fish production from 1980 to 1990. The highest catch was estimated in 1987 at 2,200 t and valued at RM 8.49 million (1US$ = 2.5 RM). These estimations were considered underestimations because some of the coral reef fish families (*e.g.*, Acanthuridae, Scaridae) and the amount of catch for the live-fish trade were not included in the analysis. The live fish-reef food fish trade (and culture of *Tilapia* spp. and *Lates calcarifer*) had begun in mid-1980s and had generated a production of 3,000 t valued at RM 0.35 million in 1992 and increased to about 7,000 t valued at about RM 0.78 million in 1994. In 2001, the contribution of cage-culture of coral reef fishes alone was 550 t valued at RM 9 million. The yield of the western coast of Sabah was estimated in 1978 at about 20 t/km^2/yr but none was known for the eastern coast of Sabah, where more reefs are found and are likely to produce more than the western coast in capture fisheries and cage-culture of coral reef fishes.

The status of coral reef fisheries is declining due to high effort and, consequently, research is needed to provide scientific information for management. On-site gathering of coral reef fisheries statistics was suggested to have accurate information on catch composition and statistics. Research on basic biology and ecology are urgently needed, particularly for hermaphroditic species such as the highly-valuable groupers whose social structures and populations are more vulnerable to fishing pressure. Information from these studies, recruitment patterns, and socio-economic factors are needed for specific, simple biological regulations and ecosystem-based management.

MACROBENTHIC COMMUNITIES OF THE SITA – SWARNA ESTUARINE COMPLEX, WEST COAST OF INDIA

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Macrobenthic communities in the Sita-Swarna estuary are characterized by temporal and spatial changes in their component populations. These patterns of estuarine distribution can be explained in terms of distribution and abundance of euryhaline and opportunistic species of marine and estuarine origin. The fauna was unstable at different sites in the two estuaries. The marine forms were more abundant in the region of the river mouth while, the estuarine endemic species tend to be dominant in the middle and upper regions of the estuary. Salinity and sediment properties (Sand, Silt, Clay Grain size, Organic carbon and Chlorophyll-a) influenced the community structure.

The index of diversity showed temporal and spatial variations. A decline in faunal density was observed from the mouth towards upstream due to decrease of salinity and sediment properties. The polychaetes and bivalves accounted for more than 80 percent of the population. The population density was highest in the mesohaline zone of the estuary due to presence of high density of *Meretrix casta* and *Katalysia opima*. The polychaetes were dominant group followed by bivalves and crustaceans.

Table 1. Annual variation of biotic parameters at different sites in Sita-Swarna estuarine complex.

Variable	Sites			
	S1	S2	SW1	SW2
Shannon- Wiener Diversity Index	2.17 ± 0.54^{c}	1.73 ± 0.82^{a}	2.23 ± 0.64^{c}	1.86 ± 0.39^{a}
Biomass (g/m^2)	5.68 ± 0.37^{b}	1.85 ± 0.30^{a}	1.68 ± 0.2^{c}	2.64 ± 0.15^{a}
Population Density (No/m^2)	718.5 ± 1.78^{a}	818.73 ± 2.9^{b}	$704.8 \pm .81^{a}$	723.7 ± 0.17^{a}
Species Number	8.54 ± 7.82^{a}	21.8 ± 19.7^{b}	10.28 ± 8.74^{a}	9.56 ± 13.84^{a}

Superscripts with same letters in each row are not significant at 0.05 level
S1 & S2 = Sample sites in Sita estuary
SW1 & SW2= Sample sites in Swarna estuary

BLOOMING OF PHYTOPLANKTON IN RELATION TO NUTRIENT FLUX IN HOOGHLY ESTUARY, NORTH EAST COAST OF BAY OF BENGAL

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Phytoplankton requires several nutrients for growth and important among these are nitrogen and phosphorous. Those organisms which have siliceous frastules (eg. diatom) also require a supply of silicon. Observation of these nutrients (N,P,& Si) in an aquatic environment facilitates understanding of plankton bloom. The distribution of nutrients in the coastal waters of north Bay of Bengal is controlled by the nutrient flux from the Hooghly estuary (20° 32′ – 20° 40′ N and 88° 05′ – 89° E), one of the major rivers of India. Annual fluxes of nutrients (N, P & Si) were calculated as 3,66,033 mt nitrate – nitrogen, 146 mt phosphate – phosphorous, and 36,89,817 mt, silicon - silicate from Hooghly river to the Bay of Bengal. It was observed that in the pre monsoon season, nitrate, phosphate & silicate were removed from the water but during the monsoons only phosphate was removed while nitrate and silicate showed considerable addition. In post monsoon there was a removal of silicate and nitrate while phosphate showed a 10.2 –13.7% increase. Minimum values of growth rate of phytoplankton were found during monsoon (0.2 doubling d^{-1}); and maximum during pre monsoon (0.68 doubling d^{-1}). The characteristic species of phytoplankton in bloom proportion during post monsoon and early pre monsoon period were *Coscinodiscus excentricus*, Coscinodiscus *radiatus*, *Rhizsolenia alata*, *Bidhulpha sinensis*, *Dityllum brightwelli* and *Pleurosigma elongatum*. A total surface area of a phytoplankton species equals to 10^7 μm^2 l^{-1} was considered as bloom forming at any particular time. The overall cell counts varied from 1720 to 7080 cell l^{-1}. Total surface area of phytoplankton varied from 1.19 - 7.24 x $10^7 \mu m^2$ l^{-1}. Some differences of blooming characteristics were found between the inner and outer firth of the river. Blooming time of Rhizsolenia *alata* and *Bidhulpha sinensis* extended between November and December at the outer firth and in the inner firth, it was observed only during December. Apart from this *Coscinodiscus excentricus*, *Coscinodiscus radiatus* and Pleurosigma *elongatum* attained blooming proportion during August- October at the outer firth which was not found at the inner firth. Similarly *Dityllum brightwell* reached blooming proportion during April in the outer firth only. Therefore in the coastal waters off the Hooghly estuary successive blooming of different species was observed through out the year whereas it was found for a short period (late post monsoon-early pre monsoon only) at inner firth.

NUTRIENT CHANGES IN A SHALLOW TROPICAL RESERVOIR DURING WET AND DRY SEASONS

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Changes in nutrient levels in lacustrine systems are of great importance as excessive nutrient concentrations often lead to harmful algal blooms. Monitoring of nutrients in this fragile aquatic environment is required for efficient aquatic ecosystem management and control of eutrophication.

The present study was carried out to investigate the changes in nutrient levels during the dry (March to May) and rainy (June to August) seasons in Bukit Merah Reservoir, Malaysia. The reservoir is typically shallow ranging from 0.5-5.0 m depth.The reservoir has a catchment area of 480 km^2, consisting mainly of agriculture land. It provides water for irrigation and domestic usage, source of fish and recreational activities. Four different stations were chosen for this study. Station 1 (5^0 01.89'N and 100^0 40.134'E) was located near the Kurau River, Station 2 (5^0 01.083'N and 100^0 39.532'E) near the main outlet of the reservoir, Station 3 (5^0 00.802'N and 100^0 39.980'E) at the centre of the lake and Station 4 (5^0 00.248'N and 100^0 39.983'E) was located near the recreational areas. Water samples were collected monthly for total ammonium nitrogen (TAN), nitrate nitrogen (NO_3-N), nitrite nitrogen (NO_2-N) and soluble reactive phosphorus (SRP) analyses. Physico-chemical parameters of Bukit Merah Reservoir such as temperature, dissolved oxygen, Secchi disk and pH value ranged from 27.50-34.02^{0}C, 2.62-7.49 mg/L, 0.65-1.50 m, 6.43-7.82 respectively.

The TAN concentrations ranged from 0.025 mg/L to 0.063 mg/L during the six month study period, with significantly higher concentrations recorded at station 1 during the month of August (rainy season) compared other stations. Similarly, station 1 had the highest levels of nitrate nitrogen. Soluble reactive phosphorus (SRP) ranged from 0.003 mg/L to 0.052 mg/L. The SRP levels were found highest during August, whereas the lowest levels were found in April. In general, higher levels of nitrate and nitrite nitrogen were observed during rainy season. The results suggest that high concentration of nutrients were possibly added to the reservoir during the rainy seasons as a result of surface runoff and river inflow from the catchment area.

PRELIMINARY STUDIES ON PRAWNSAT NAM OU RIVER, LUANG PRABANG PROVINCE, LAO PDR

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A number of indigenous prawns are found inside the waterfall in LuangPrabang Province in Lao PDR. The present study on these prawns at waterfall in Nam Ou River at Na Pho village, Muang Ngoy District was undertaken during April 2001-April 2002 by the Living Aquatic Resources Research Center (LARReC) in collaboration with local fishermen. The study was undertaken in the natural habitat of the prawn during rainy and dry seasons.

The prawn is found only during the rainy season, when the water in the River is high with high turbidity. The prawns move to fresh and clean water in the waterfall. The dissolved oxygen content of water was 7.0 -8.5 ppm, water temperature was 16-20° C.

This is a species of indigenous prawns, with weight ranging between 60-80 prawn/ kg. The fecundity is 108 eggs/prawn. In general head of male is red, while the female is light green. The size of male is bigger than female.

The prawn appears only during the rainy season from March to October. Schools of prawn ascend up to the waterfall areas during quiet period particularly at nighttime from 6.00 pm to 5:00 am. The quantity of waterfall prawn caught in these areas was about 1,300 kg/year.

This is just a preliminary study and further studies need to be undertaken to gather information on its biology, sustainable use, domestication and assess its potential for culture.

STRUCTURE, COMPOSITION AND SEASONAL DYNAMICS OF THE POSTLARVAL AND JUVENILE SHELLFISHES IN THE SUNDARBANS MANGROVE WATERS, BANGLADESH

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The structure and temporal distribution of the postlarvae and juvenile shellfish community in five river systems of Sundarbans with different salinity zones were studied; taking monthly or fortnightly day time samples with a rectangular drag net (2 mm mesh). Fifteen species belonging to 6 families of shellfish were recorded during 2 years study. Four species of shrimp (*Metapenaeus monoceros, M. brevicornis, Macrobrachium villosimanus* and *Acetes* spp.) and megalopa of crab (*Scylla serrata*) were the most abundant (79.3-96.83%) shellfish. Among commercially important species recorded, *M. monoceros* and megalopa of *S. serrata* were predominant. Monthly highest species density of 12 species was observed in the Passur river during May. The postlarval recruitment size varied with species: penaeid recruited at total length of 10-38 mm and caridean with 10-26 mm. Megalopa of crabs were most numerous, making up to 25.6% of the total shellfish catch, followed by *M. villosimanus* (21.19%), *Acetes* spp. (16.72%) and *M. monoceros* (14.38%). The commercial species *M. monoceros* was observed frequently throughout the study period in addition to crab megalopa with maximum abundance occurring seasonally from November to February in rivers of Sundarbans. No significant seasonal or lunar variation in abundance of shellfishes was observed, although major annual peak in winter for shrimp and in monsoon for crab megalopa were recorded. Total shellfish catch record showed significant monthly variations. When individual species was recorded, only *M. monoceros* represented significant ($P<0.05$) monthly variation in abundance. Abundance of *P. monodon* significantly ($P<0.05$) varied with month and between 5 rivers, although annual variation was not significant. When compared with the previous record (1992-93 and 1995-96), a declining trend in *P. monodon* PL abundance was observed during 1995-96 and 1998-99, which was slightly increased in 1999-2000.

PATTERN OF ESTABLISHMENT OF TILAPIA IN RESERVOIRS IN MALAYSIA

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Alien fish species have contributed significantly to the growth of global aquaculture production. One of the main alien fish species cultured globally and in Malaysia is the Nile tilapia *Oreochromis niloticus.* The total estimated retail value of tilapia production from different aquaculture systems covering both freshwater and brackish water area was RM 103 million in 1999 as calculated from Annual Fisheries Statistic by Department of Fisheries Malaysia.. Five species of tilapia have been introduced into the country, but most of the culture is based on *O. niloticus, O. mosambicus* and hybrids. Tilapia has established in many water bodies in Malaysia. Growth in tilapia culture had caused concern over possible invasive nature of the established tilapia populations. This is more so since tilapia is a very hardy species that can live in most of the freshwater ecosystems and a very prolific breeder with potential to displace native species. In aquaculture the possibility of escapes cannot be ruled out and these escapees will lead to the establishment of feral population if conditions are favorable. However the invasive nature of feral populations of tilapia is yet to be determined. This paper examines the relationship between aquaculture in cages and pond culture near water bodies and the establishment of feral populations in different reservoirs across Peninsular Malaysia. A total of 18 reservoirs were chosen based on their potential to provide suitable conditions for colonizing by tilapia. The analysis of the match between the species biological requirements against conditions in receiving environment has led to an understanding of the requirement for establishment of tilapia in these water bodies. With adequate information, aquaculture using alien species can be developed without adverse impact on indigenous aquatic biodiversity.

THE IMPACT OF INTRODUCED SPECIES ON THE GENETIC DIVERSITY OF NATIVE FRESHWATER FISHES IN MALAYSIA

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This study examined several introduced and established freshwater fishes and their impact (ecology and genetics) on native species in Malaysia. Six study sites were identified and selected for the project: 1) Serting and Jempol Rivers in Negeri Sembilan (for *Oreochromis niloticus* and *Barbonymus gonionotus*); 2) Sungai Besar in Selangor and Kinta River in lower Perak (for *O. niloticus* and *Trichogaster pectoralis*); 3) Balai Ringin in Serian, Sarawak (for *Helostoma temminckii*); 4) Bakong River, Tinjar River and Loagan Bunut Lake in Miri, Sarawak (for *H. temminckii*), and 5) Balung River in Tawau, Sabah (for *O. niloticus*). The studies on food habit showed that introduced species such as *O. niloticus*, *H. temminckii* and *T. pectoralis* shared the same diet with indigenous species, thus resulting in potential competition for food and habitat. Molecular studies using Restriction Fragment Length Polymorphisms (PCR-RFLPs) of amplified mitochondrial DNA genes identified several molecular markers useful for discrimination between indigenous species as well as between indigenous and introduced congeners. Population genetics and phylogenetic studies using mtDNA showed that introduced species generally exhibited higher or comparable genetic diversity compared with native/indigenous congeners in their particular habitat. Overall, all introduced species studied in the project have adapted well to the local environment and even dominated the particular habitat where they have been introduced (i.e. *H. temminckii* in blackwater areas in Sarawak). The current ecological (food habit and macro-habitat studies) and molecular (genetic diversity) analysis pointed towards the potential of the introduced species having a negative impact (indirect) on the viability of native/indigenous species.

Table 1 Levels of genetic diversity between several introduced and indigenous/native freshwater fishes in Malaysia based on mtDNA sudy

Type of mtDNA	Species	Genetic diversity (Pi)
	Helostoma temminckii	0.04
Introduced	*Oreochromis niloticus*	0.06
	Trichogaster pectoralis	0.03
	Barbonymus gonionotus	0.04
	Anabas testudenius	0.02
	Trichogaster trichopterus	0.01
Indigenous/Native	*Cyclocheilichthys apogon*	0.03
	Barbonymus schwanenfeldii	0.02
	Puntius bramoides	0.02
	Tor douronensis	0.02

STUDY ON AN INTRODUCED FISH, *Helostoma temminckii* IN BAKONG RIVER, MIRI, SARAWAK: FACTORS AFFECTING ITS ESTABLISHMENT & SOCIO-ECONOMIC IMPACT

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The fish samplings were carried out in Bakong area, which includes Bakong River itself and its main tributaries, namely Karap River and Nyabor River. Samplings were done using various mesh sizes of gillnets and castnets. A total of 12 family, and 24 species of fish fauna were collected during this sampling. By the analysis of number of individual for each species, the *Helostoma temminckii* species is the most abundant fish in this area during this sampling. There are few factors that make this species established well in Bakong area. This well-established species are found mainly in the blackwater areas, with slow-moving or almost stagnant water and mostly covered by floating macrophytes. This species also found can tolerate with extreme habitat, where the dissolved oxygen (D.O) during this sampling was as low as 0.33 mg/L and the pH readings were less than 7.00 unit. Other factors are the availability of food in the habitat, high in reproduction, and suitable breeding grounds. Stomach contents analysis was also carried out on *H. temminckii* where it was found that this species are planktivorous – feeds on plankton, mostly diatoms, which are the most dominant group beside green algae and other planktons. Diatoms and green-algae (Chlorophyta) were also found abundantly in the water columns, particularly where *H. temminckii* found abundantly. This species has brings a positive impact to the local community socio-economic in this area for this few decades in terms of protein and source of income.

EXOTIC RED-BELLIED *Piaractus brachypomus* IN THE PHILIPPINES: POTENTIAL IMPACT TO RICE ECOSYSTEM

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Exotic fish species particularly those introduced in the ornamental aquarium fish trade industry contribute to fish fauna diversity in the Philippines. Some of these species originated from South America and Africa and have adapted very well to Philippines climatic conditions. Red-bellied pacu *Piaractus brachypomus*, a native of Brazil and a food fish in South America, also referred as *Colossoma macropomum* in some reports, was introduced to the Philippines from Singapore between1980-1989, and can very well reproduce in ponds.

The study investigated the impact of this fish in screenhouse rice ecosystem focusing its effect on the rice pest -freshwater golden apple snail (GAS) *Pomacea canaliculata* and rice plants.

The experiment consisting of 1 m x 1 m microplots planted with 21-day old IR64 rice seedlings (spacing: 25 cm x 25 cm) was conducted in a screenhouse. Microplots were separated with plastic sheets and a water depth of 10 cm was maintained. Standard management and culture practices for transplanted rice were employed. Two sizes of GAS: < 10 mm and 10-20 mm shell height were introduced in the microplots immediately after rice transplanting at a density of 8 GAS m^{-2}. GAS sizes were color-coded. *P. brachypomus* with initial sizes: small (<10 g), medium (11-20 g) and large (30-50 g) at three densities (1, 2 and 3 fish m^{-2}) were stocked one week after rice transplanting and cultured for three weeks. Initial and final individual length, weight and mouth opening of fish were measured. At the end of test, surface soil $plot^{-1}$ was sieved to retrieve and count all GAS then measured for shell height. Rice plants $hill^{-1}$ were counted and noted for damage by the fish. The main effects of fish density and size and their interaction on GAS density and rice plants were analyzed.

The study showed that *P. brachypomus* significantly reduced GAS density by 63% ($P<0.05$). The main effects of density, size and their interaction of *P. brachypomus* did not make any significant difference on the fish predatory selectivity on different snail sizes. Predation of different sizes of GAS is greatly influenced by the fish mouth opening, a function of body size. It was observed that *P. brachypomus* with initial weights: 13-49 g at a density of 2-3 fish m^{-2} can damage 20-day old transplanted rice but not smaller fish (<10 g) at density 1-3 fish m^{-2}. Damages caused were uprooting and cutting of stems similar to the damage by field rats. Further study should be focused on the effect of food pressure in the system resulting in opportunistic feeding of the fish.

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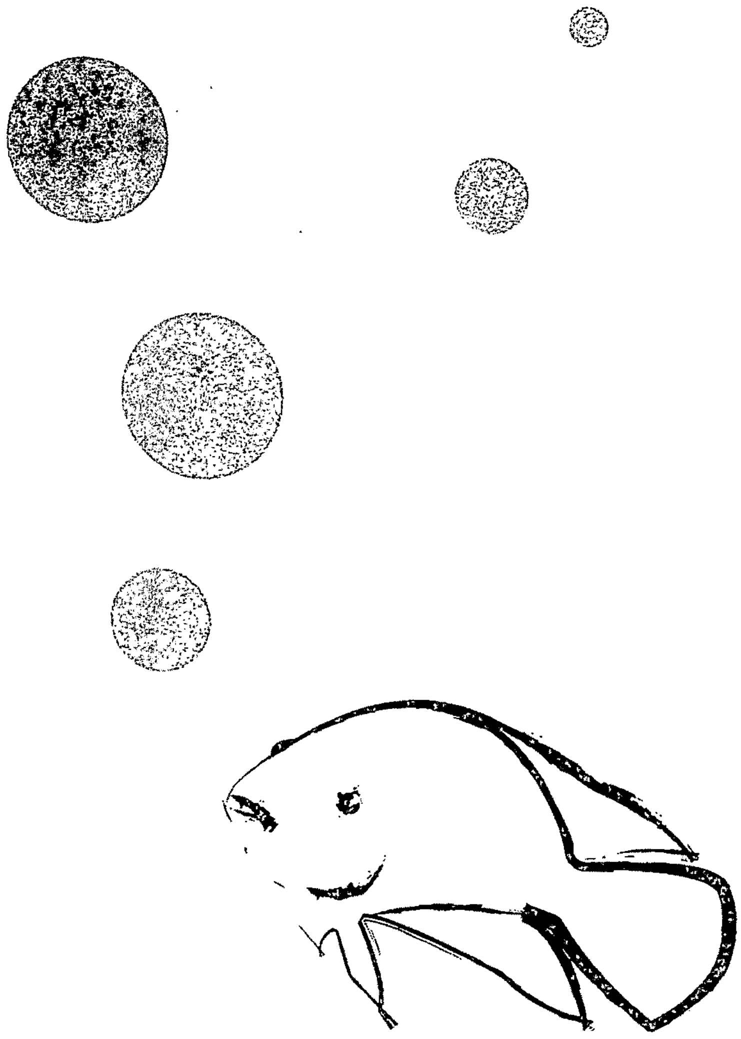

NO SHELLS, NO LANGALANGA: HARD TIMES IN MALAITA, SOLOMON ISLANDS

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Shell money production defines the history, culture and economy of the people of Langalanga Lagoon in Malaita, Solomon Islands. Central to the harvesting, procurement of raw materials, manufacture and trade of shell money is the skilled labour of women. Shell money producers in traditional villages learn their craft from their mothers and grandmothers and for many; it is a life-long and often exclusive source of livelihood.

In this paper I will explore the recent history of the shell money trade, gender roles, the state of the shell resources, historical and current resource management arrangements and the many challenges facing shell money producers in our rapidly globalizing society. Some of the difficulties are felt by both men and women who engage in the shell money trade; others are particular to women.

Currently the shell fishery is unregulated. In the past, before Christian missionaries abolished many of the traditional cultural ceremonies, the chiefs on Malaita controlled the exploitation of shell fisheries through the use of area bans and gender restrictions. In the absence of such traditional controls the over-harvesting of shells to make shell money has driven key species to commercial extinction in Langalanga lagoon. Downward trends are compounded by the use of destructive fishing techniques such as blast fishing.

Over the same period, changing technologies have allowed faster manufacturing of shell products. This technological change as well as local depletion of shells has stimulated changes in gender allocation of production tasks.

Shells are increasingly imported from other provinces of the Solomon Islands. Markets for shell products have expanded owing to intermarriage of Malaitans with people from other islands, and because of tourism. The central market for purchasing shells and for selling shell money and shell jewellery is the capital city, Honiara, on Guadalcanal Island. This development has had profound impacts on the shell money producers and their families.

Threaded through the history of the shell industry are aspects of the ethnic and cultural identity of the shell money producers, many of whom are very poor, effectively landless and seriously constrained in terms of economic alternatives. Recent ethnic tension and unrest has exacerbated the difficult life of these lagoon communities.

SUSTAINABLE AQUACULTURE DEVELOPMENT: IMPACTS ON SOCIAL LIVELIHOOD OF ETHNIC MINORITIES IN NORTHERN VIETNAM WITH EMPHASIS ON GENDER

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The project titled "Aquaculture Development in Northern Uplands" aimed during 1999-2002 at alleviating poverty in three provinces by diversifying rural development through the promotion of sustainable aquaculture activities, building capacity of the local population and project staff in addressing household food security issues, reducing malnutrition of disadvantaged ethnic minorities (Thai, Kinh, Tay, Hmong, Dao and most of them were Black Thai) and especially women. The project stressed on strengthening an extension network and improvement of seed production and delivery system among the target groups at the remote area. Moreover, it gave a high priority to gender education and women's involvement in all activities. The project was implemented by the United Nations Development Program, provincial departments of Agriculture and Rural Development in 3 pilot provinces, Food & Agriculture Organization of UN in cooperation with the Vietnam Ministry of Fisheries. The Project farmers included people involved in various aquaculture practices such as grow-out fish farming, hatching, nursing and integrated farming methodologies such as VAC (horticulture-aquaculture-livestock), rice-fish, & cage culture farming.

TABLE 1 Aquaculture division of labour by gender in the project areas

Tasks	Men	Women	Both	Children
Pond dyke construction	√			
Removal of rocky/stones from pond bed	√			
Water draining	√			
Drying pond bottom	√			
Liming			√	
Stocking	√			
Feeding & fertilization			√	
Fish health check & disease control	√			
Harvesting			√	√
Marketing			√	

This project had introduced and tested two new management practices for poverty reduction, which could be considered for replication under the Hunger eradication & poverty reduction & others program in Vietnam. First, the establishment of CAG - small responsive social group and used it in creating an enabling environment & mobilizing the involvement of the local communities and their organization in planning and implementing the project. Secondly, the role of CAG in organizing a participatory extension & credit support service to best ensured the delivery of technology and financial package assistance to poor disadvantaged & isolated ethnic communities of whom more than 50% were women. It is found through a field study among the project beneficiaries at the project area showed (table 1) that the women play a vital role in aquaculture activities, although they are not involved in any activity without the support from the men. Nevertheless, in the marketing, feeding, fertilization women are significantly more involved than men. Many women are not only involved in aquaculture but in a number of on-farm activities, such as arable farming, husbandry, additional work at home. The total time inputs of women in aquaculture production were found to be generally larger than of the men. Nevertheless, the power of women in making decision processes was much lower. Through emphasizing the need for capacity building of women in aquaculture techniques and micro-credit & savings training respectively, and increasing their access to credit via the Vietnam Women's' Union the project empowered these women significantly. Their opinions were taken more seriously within their households and within the community.

GENDER AND COASTAL ZONE BIODIVERSITY

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The term 'gender' refers to socially determined roles and responsibilities of men and women and the relationship between them in the society. The concept is widely misunderstood and seen as synonymous with women. Women in development recognise the role of women in sustainable development. If biodiversity is to survive men and women should play an equal role in its management. A coastal zone supports human life through many ways including food production, fishing, aquaculture and agriculture for livelihood, fuel, water, fodder, and housing, waste disposal, schooling, religion and recreation. In all these activities are governed by gender roles and relations. In order to examine the gender concerns in use of costal bio resources a study was undertaken in a typical coastal region in India selecting two villages. An attempt was made to identify the major changes in coastal zone biodiversity over a period of two decades during which great strides occurred in marine fisheries and aquaculture. A participatory appraisal of the positive and negative impact of the changes on food and livelihood security revealed that that development efforts in general improved the infrastructure for improving income, education, health and food security, sustainability issues such as paddy VS shrimp, disease in coconuts, drinking water scarcity and pollution contributed to deterioration of coastal zone bio resources and posed challenges to the basic household food security as perceived by men and women. Biodiversity interventions help to maintain bio resources, provide diverse occupation and ensure food security for the rural poor. Conservation of biodiversity can be achieved through the use of scientific innovations integrated with development schemes and linking them with self-help groups of men and women. Some successful biodiversity Interventions by research institutes and development departments in the country, which were useful in educating the stakeholders of coastal zone on the importance of coastal zone management and maintenance of bio resources, are also discussed.

ROLE OF WOMEN AND CHILDREN IN THE MANAGEMENT OF MUSSEL AND OYSTER FARMS IN THE COASTAL AREAS OF CAVITE, PHILIPPINES

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The coastal dwelling population of the Philippines, particularly the province of Cavite in Luzon Island draws heavily on coastal ecosystems for mussel and oyster production, transportation, recreation (e.g. resorts) and waste disposal. The rapid development of marine coastal areas in the province (which is near Manila) faces a significant risk of degradation from many anthropogenic and industrial activities. In this context, the coastal ecosystems of this province are perhaps one of the most threatened areas. Rural aquaculture of bivalves such as mussels (*Perna viridis*) and oysters (*Ostrea* sp.) has been around for several decades in the coastal areas of Cavite, Luzon, Philippines.

Several days and weeks were spent during the months of October and November 2002, May to June 2003 and January to April 2004 in the coastal areas of Cavite to collect ethnographic data on mussel and oyster farm operators, farmers, women and children of the fishing communities. Interviews were carried out during informal and formal meetings and one-on-one interrogation. No stratified sampling was used, rather anyone who was willing to talk or share his/her views about the role of women and children in the management of mussel and oyster aquaculture were considered in the study. All the primary data were organized toward the end of every fieldwork. In order to maximize the number of respondents, each respondent was requested to recommend/suggest other respondents in the area. A semi-structured questionnaire was used as a general guide during interviewing. There were *ad hoc* questions asked whenever the thoughts that were given are worth following up.

The paper discusses the views of officers of women organization, elderly Cavite women, fish sellers, ordinary coastal dwelling women, children, and other coastal dwelling people about women's and children's role in the management of mussel and oyster farms in Cavite. This was discussed by looking into the wider context of Philippine society. Moreover, the study also generated some information on aspects dealing with the structure and operation of mussel and oyster farming, some management conflicts and the extent of involvement of women and children in mussel and oyster aquaculture in the coastal areas of Cavite, Philippines.

SUBSISTENCE, SURPLUS AND SEAWEED: WOMEN'S FISHING AND MARINE WORK IN KIRIBATI

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This paper locates women's fishing in Kiribati, a Micronesian Island nation,in a broad social, economic, ecological and cultural context arguing that the material as well as the symbolic and expressive dimensions of fishing must be examined for an understanding of gender. Based on data collected in tandem with fisheries staff on seven atolls in Kiribati, women's knowledge and practice of fishing will be summarized. Women's marine related work in production, processing, seaweed cultivation for the export market and distribution which includes marketing as well as the traditional exchange of *Kaonono* will be explored. Women's productive and expressive marine activities, which are interwoven with cash and subsistence and the "modern and traditional", are it is argued, diverse and essential to the family, economy and society in Kiribati.

Through an analysis of fisheries production in Kiribati, the central importance of the reef and lagoon or more generally the inshore fishery was underlined. Women's fishing must be understood in the context of the organization and the priorities at household, village and at national levels. The continuing importance of the subsistence and the inshore fishery will be demonstrated by examining the structure of the fisheries sector. The limitations of the dichotomies of reef/ocean; cash/subsistence and male/female fishing which have been most frequently used to think about fisheries will be a key theme in this paper. An analysis of these western analytical constructs will foreground the issues of representation and I shall argue that such constructs have "hardened" the division between the reef and ocean; the cash and subsistence sectors and women and men's fishing in Kiribati. And in so doing have diminished the importance of women's fishing.

This paper hopes to demonstrate that understanding gender relations in a marine society requires not only empirical data but a rethinking of the categories used to analyze and represent women's work. The dichotomies frequently used to understand fishing such as male/female, reef/ocean and subsistence/cash, miss out on the rather ambiguous nature of the relationship between those categories and the nexus between the gendered material and symbolic realms in fishing economies.

AN INTEGRATED APPROACH ON GENDER ISSUES OF FISHERIES PROJECT IN COASTAL AREA OF BANGLADESH: PROBLEMS AND CHALLENGES

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There are many fisheries projects in Bangladesh which addressed both male and female participants as target groups. The Government of Bangladesh has launched Patuakhali Barguna Aquaculture Extension project (PBAEP) in the south and southeast coastal areas of Bangladesh. The project is supported by DANIDA (Danish International Development Agency) with cooperation from the Department of Fisheries (DoF) of the Ministry of Fisheries and Livestock (MOFL), Bangladesh and implemented by two local NGOs. This project was initiated in 1997and will terminate in 2004. It aims to strengthen the socio economic status and physical well -being of men and women and to improve their active participation in social and economic development as well. The project targets integrated pond farming (IPF) with emphasis on community based fisheries management (CBFM). In the project area the women play an important role in integrated pond farming activities; the project stresses on development of primary capabilities for the women initially on aquaculture techniques. PBAEP integrates gender issues in many of their policies and program. This paper aims to find out the problems and challenges in implementing gender-mainstreaming policies which are formulated and undertaken by the project authority.

Daily 'Time use' and 'Division of labor' in IPF study showed that fish farming requires additional time and labor which a woman may not have, yet women are more involved than men in the pond farming activities. Men enjoy more leisure period as they do not perform household chores which culturally, are relegated to the women. Women are usually reluctant to attend the training program and to be knowledgeable on basic concept of fish farming training. The main cause identified is heavy responsibility in the homestead. To understand the factors that affect women's effective participation in fishery and identify the problems and constraints faced by them, discussions were held with both women and men. While in theory women have access to aquaculture training and extension, in practice, many of the women think, 'Men should buy fingerlings from the market". They are not confident enough to find out better fingerling quality for stocking the pond since they consider this a man's responsibility. The research findings conclude with the recommendation to provide credit, form sex separate groups and to provide extensive gender training using training materials (flipchart), avoiding any social conflict for extension worker and farmer groups and encouraging women who are less confident to speak up in the presence of their male partner in the training and meetings. Some problems encountered in the project are that fish farming is quite expensive for the rural women groups and the extension workers are still confused about gender knowledge and gender gap.

SUCCESSIVE INVOLVEMENT OF WOMEN: CLOSED WATER TO OPEN WATER FISHERIES

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Women are involved in small-scale closed water fisheries activities at different stages in Bangladesh. They have already been recognized as good managers for fish culture activities in homestead ponds, nurseries, cages and even rice fields. Their capacity in contributing to the household economy as well as national economy in the fisheries sector is increasing significantly. In 2000, 47% were women in Caritas Fisheries Program (CFP) out of 18,269 beneficiaries, and the majority of them were involved in culture based fisheries activities. Women are increasingly involved in open water fisheries management system even in the teeth of social issues. Caritas is a Non-Government Organization founded in 1967 in Bangladesh for the empowerment of the resource poor community and ensuring the significant involvement of women. CFP deals with Community Based Fisheries Management (CBFM), Management of Aquatic ecosystem through Community Husbandry (MACH) and Sustainable Environment Management Program (SEMP). Under the open water fisheries project in SEMP, the rights of the poor fishers accompanied with the specific strategy for women involvement in conservation were initiated. In 2003, these projects attracted a total of 463 groups, with women comprising 165 groups with 3,125 members (32%). They attend different sorts of training program, practice various kinds of income generating activities, increase family earnings as well as savings and help in meeting their family demands. Women's savings in CBFM project was around USD 4,571 (BDT 255,974) in 2003. Although women involvement and their performance in open water fisheries are not yet so remarkable compared to men, they are progressively contributing to conservation of natural resources by raising awareness on various issues such as the Fish Act, fish-ban period, prohibition of harmful gears, pesticides/insecticides and chemical fertilizers. Caritas provides support services to women with consideration given to their culture, and resources available at their homesteads, so that they could work easily honoring the social norms. Although women are performing a lot of work, they have still limited control over their income, use of money as well as other decisions of their families. We should study these issues and suggest ways to overcome them. The paper describes the role of women in the fisheries sector from closed water to open water in Caritas.

"CONFINED MOBILITY: THE GENDERED IMPACTS OF AQUACULTURE DEVELOPMENT IN NORTHEASTERN THAILAND"

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The paper addresses the trend of livelihood diversification in agrarian communities that results from growth-oriented development policies. This article uses empirical data from rice-farming communities in Maha Sarakham province, Thailand that are diversifying into freshwater aquaculture to examine the impacts of such changes in economic activity. The case study compares inland cage and subsistence pond aquaculture to analyze the effects and benefits associated with the activities' introduction and production level. The results suggest that significant differences exist between the two communities with cage culture leading to greater benefits than pond culture, including higher income and mobility levels. However, the benefits from diversifying into commercialized aquaculture are unequally distributed between men and women as evidenced in extra-community mobility levels. Amongst cage culturists, female culturists are significantly less mobile than male culturists, and despite female cage culturists' high income levels, they exhibit similar mobility levels to women not engaged in the activity. The combination of the corporate organization of cage culture, kinship networks and traditional expectations, and household responsibilities continue to confine women's mobility to within the community—inhibiting an increase in mobility that male cage culturists experience. While livelihood diversification into activities such as cage and pond culture provides significant benefits, the paper recommends a critical review of the impacts on the individuals and households involved.

GENDER AND GENERATION: CRUCIAL ASPECTS OF LOCAL FISHERIES MANAGEMENT IN LELEPA, VANUATU

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Lelepa is a small island off the northwestern coast of Efate in central Vanuatu. The community of seven villages comprises a total of 80 households. Typically, livelihoods depend on a mix of subsistence and small scale commercial fishing, farming and handcraft production. A few men are employed in construction or tourism. Women are responsible for providing family food and often, for finding cash for school fees and church contributions. The main sources of protein for families are fish and shellfish. Cash is earned by selling fish, shellfish, garden products and handcrafts in the capital city, Port Vila.

This case study reveals the gender roles and attitudes at work in the inshore fishery and its management in Lelepa.

The history of the inshore fishery of Lelepa Island is the story of changing technologies, changing gender roles and, most profoundly, changing needs and priorities of fisherpeople. In the past men caught fish using hand spears and the fish were plentiful and tame. Harvests were shared among the people, not sold. Women gathered shells, octopus and small fishes using their hands and sometimes, plant poisons. Over time various new technologies were introduced, some species developed a market value, new infrastructure allowed for transportation to an urban market and gender roles changed. Most new technologies were adopted only by men, while women to this day use bare hands and hook and line and are excluded from fisheries involving spear guns, nets and deep water reels. The exclusive role of women as shellfishers has also changed. When *Trochus* shell became commercially important, men entered that fishery and today men gather shellfish for food while on fishing trips.

From an initial position of plenty, the communities on Lelepa have, through a process of commercialization and over-harvesting, reduced their fishery to a shadow of its former self. Habitats have been degraded; fish stocks depleted and shellfish are so scarce that many women have given up taking any to market.

Since the mid-1990s, the people of Lelepa have embarked on a process of local management and attempted restoration of health to inshore fishing grounds. Following traditional custom, this process has been led and dominated by elder males in the community. The management strategies involve a protected area and harvesting bans. Constraints of history and culture work against the inclusion of women and youth, two groups who are central agents in harvesting. Because they have been excluded from decision-making youth in particular defy fisheries rules. Women are also disregarded even though they play a critical role in educating small children concerning conservation. The views of men and women, elders and youth reveal a basic lack of communication around marine resource issues and a tendency to label "the other" as destructive, greedy or ignorant. Until this changes, the prospects for the future are poor. The knowledge and energies of women and youth are needed for successful local management.

SEX AND NUTRITIONAL STATUS OF UNDER SEVEN CHILDREN IN THE COASTAL BARANGAYS IN BUENAVISTA, GUIMARAS

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Providing optimum health to children regardless of sex must be a priority concern. This paper describes the nutritional status and determines if there is a significant difference in the nutritional status of underseven male and female children in the coastal barangays of Buenavista, Guimaras. Buenavista is the biggest in terms of size and population among the five municipalities of the island province of Guimaras, which is located in Central Philippines. Seventeen of its 36 barangays are coastal.

Secondary data from the Municipal Health Office were used. Data were available for sixteen barangays and contained parent's names and the child's name, birthdate, age, weight and nutritional status based on weight-for-age index. Barangay Nutrition Scholars weighed the children during the last week of February to the first week of March 2004. The data collected were organized and summarized using frequency and percentages and chi-square test was used to determine if there was significant difference in the weight status of male and female children.

A total of 1,731 children were weighed. Of these, 49.68% were males and 50.32% were females. Three out of every ten children were malnourished, while seven weighed normally. 25.82% of the children were underweight while 2.48% were overweight children. For children with normal weight, 52.05% were males and 47.95% were females. For overweight children, 62.79% were males and 37.21 % were females. For undernourished children, 58.17% were females and 41.83% were males. The difference in the weight status of male and female children was significant.

By age group, there was a significant difference in the weight status of male and female children aged 12 to 59 months (1 year to 4 years) old. There was no significant difference in the weight status of male and female children aged below one year and aged five to below seven years old.

The data are vital inputs in the development of intervention for the improvement in nutrition, particularly the weight status of underseven children in the coastal barangays and of all children in the municipality as a whole. A follow-up study must be conducted to assess why there was a significant difference in the weight status of, particularly of aged one to four years old, male and female children. Among other things, household food patterns, practices, and beliefs should be investigated.

NUTRITIONAL STATUS AND SOCIO ECONOMIC EMPOWERMENT OF FISHERWOMEN IN COASTAL ECO-SYSTEM OF ANDHRA PRADESH, KARNATAKA, KERALA & TAMILNADU

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This study was carried our in the coastal areas of Andhra Pradesh, Karnataka, Kerala & Tamilnadu. From these states, 13 districts and 27 villages were selected based on the method of fishing i.e. mechanized, motorized or non mechanized. A total of 5,744 households were covered. Cereal consumption was found to be high in Andhra Pradesh followed by Kerala, Karnataka, and Tamilnadu. Pulse consumption was high in Kerala when compared to other states. The overall energy intake of the fisherwomen was 1827 K.cal / day, protein intake 50.6 gm / day, carbohydrate 343.5 gm/ day and fat 27 gm/ day. The mean intake of micro nutrients was less than the recommended dietary allowance (RDA). The body mass index (BMI) was 21.3. 49 % of the women were normal, 17% were low normal, 10.5% were mildly malnourished, 4 % were moderately malnourished, and 2.9 % were severely malnourished. Only 11.5% were over weight and 4.6 % were obese. A sub sample of 915 women was clinically observed and prevalence of clinical symptoms like angular stomatitis, cheelosis, bleeding gums and dryness of skin were 34.8%., 31.0%, 42.8%, and 44.2% respectively. 72% of women were anemic. Very few households (15.41%) maintained livestock for domestic support and earned income out of it. About 60% of the fisherwomen were involved post-harvest activities to earn income. Food expenditure at 60.68% of earned income comprised the major share of spending. The higher the Engel's coefficient the lower was the standard of living. Indebtedness was a serious problem faced by 44.9% of the respondents who had availed loans mostly from non-institutional sources (78.91%).

INTEGRATING THE GENDER PERSPECTIVE IN NUTRITION AND OCCUPATIONAL HEALTH IN FISHERIES SECTOR

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Nutrition and health are fundamental human rights. In this context workshops on "Health and Nutritional Security for fisherwomen" were organized at urban and rural fishing villages in the state of Maharashtra, India. Geographical locales of study were Greater Mumbai (Versova and Khar Danda) and Thane (Masavan and Mahim). Workshops focused on health checkups for 276 fisherwomen. Parameters checked were Body Mass Index (BMI), blood pressure (B.P.), complete blood count which included haemoglobin count and random blood glucose level, resting heart rate and ECG. In addition to health checkup, various interactive lectures and demonstrations on good health and nutrition were arranged by resource persons. Results revealed that about 40% of fisherwomen had haemoglobin level less than the normal range. Random blood glucose level for most were found to be as per recommended range and was not a major problem. High percentage of urban fisherwomen were found to have high B.P. whereas rural fisherwomen had low B.P. BMI values suggested that there were overweight and underweight problems in urban and rural fisherwomen respectively coupled with low haemoglobin levels revealing nutrition related problems. Barring a few who had arrhythmic heart rate, heart problems was not very common as indicated by ECG results which however need further indepth investigations. A significant percentage of urban fisherwomen reported musculoskeletal pains especially severe knee pain probably due to the posture adopted by them and load of body falling on knees in maintaining the posture specially in selling fish. This is a major cause of concern as with advancement of age, problem of knee pain is very severe amongst fisherwomen and there is enough evidence to suggest this as an occupational health problem. Chemical analysis of food is under progress to ascertain whether nutrient deficiencies exist especially for calcium content. This can give some indications on the relationship between intake of calcium and knee pain. Workplace environment study has revealed that temperature and humidity were high and workload of fisherwomen was moderately heavy as measured from the heart rate, energy expenditure and rate of perceived exertion scale with very few rest breaks and odd work hours. It is necessary to address the lack of scientific data on work measures of women in fisheries. In addition to these, a number of occupational problems were documented. Exercises, correct lifting techniques, correct postures and change in adoption of postures, improved diets, rest breaks, increase in water intake etc. were suggested to fisherwomen to address these occupational problems.

A STUDY ON WOMEN'S INVOLVEMENT IN PROCESSING AND GLOBALIZATION IN FISHERIES AND AQUACULTURE IN TAIWAN

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In Taiwan, products from either fisheries or aquaculture are often processed in traditional ways. Recently, however, new packaging ideas and protocols have emerged. Women's efforts and ingenuity have contributed immensely to this novelty and have provided the cutting edge for the marketing of Taiwanese seafood products in the domestic and international market.

Questionnaires were designed to explore the competitiveness of the major Taiwanese processed aquatic products in the increasingly globalized market. Our study showed that with the help of the popular e-network in Taiwan, e-business has become possible and feasible in and outside of Taiwan. Value addition of aquatic products was obtained with suitable processing and packaging methods, and Hazard Analysis Critical Control Point (HACCP) accreditation has also made processed products more competitive.

Both local and foreign consumers were willing to pay more for certified and ready-to-eat processed seafood. There was a lucrative market also for well-designed, carved corals and processed fish larval feeds. The self-designed homepage and website plus the popularity of using commercial network among consumers provided the potential for e-marketing for now and the future. Women often created pioneering ideas in the processing of aquatic products. Women's innovativeness is often linked with their innate eye for natural beauty, and for their talent in churning out nutritious and delicious food in home cooking. The popular ready-to-eat microwave milkfish and tuna products in Taiwan are testimony to women's ingenuity in the processing and packaging area.

We recommend that:

(1) The Government should further offer training courses for women and men in e-commerce, food processing and packaging, and business economics etc;
(2) The related associations should establish a complete and informative seasonal data bank;
(3) More women should be encouraged to join and create the globalization wave and contribute as much as men or sometimes, even more;
(4) For further development, more high quality research to evaluate the future roles that the government, industry and research sectors can play to ensure sustainability of processing and globalization in fisheries and aquaculture products.

WOMEN IN FISH BORDER TRADE: CASE OF FISH TRADE BETWEEN CAMBODIA AND THAILAND

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Fish is one of the largest export items from Cambodia to Thailand. The current concept of regional trade in Greater Mekong Sub-region focuses on spacial and physical planning. It does not take into consideration the role of small traders. Normally they are grouped together as informal traders and considered as smugglers. However, if regional trade is to benefit the poor people living in the border areas, it is important that the small border traders are given central attention. This study challenges the notion that access to infrastructure especially road will benefit border traders, and attempts to contribute to the missing link in the regional trade framework – the link between trade and natural resources management.

Women are the dominant players among the small border exporters. Women traders have always been under the "protection" and exploitation by the state – either in forms of street-level bureaucrats or by military – in doing their business. The study explores the changing obstacles that women face changing macro-economic and political environment – from war zone to state monopoly of fish trade, and to opening of border and deregulation. During the time when the Cambodian border town of Poipet was a war zone, women depended on the military men to transport their fish to the border and sell to the Thais. When state monopoly of fish trade was in place, women traders had to go through the state-run company and pay them fees. When the state monopoly has weakened, new checkpoints started to sprout along their trading route, where women traders had to pay taxes and fees along the way. When they could finally keep some of these collection of fees in the Cambodian side at bay with the protest led by the fish transporters (who are all men), then they faced large hike in import tax from the Thai customs. For all these different "negotiating" parties, women traders said that they use the same strategy, that is, to "beg" and "plead". By accepting to be "protected" by the state, women traders had continued to ensure the survival of their business. Because of such negotiating style of women traders, deregulation and improvement of road did in one sense supported their business, but has not changed their relation with the state, thus they remain vulnerable to extortions from authorities.

Fish traders share the same concern as fishers in Tonle Sap Lake – the fish catch is decreasing. Because of their dependence on fish catch, women fish traders also have a stake in maintaining the sustainable use of fish resources in Tonle Sap. By exploring women traders' current relations and way of negotiating with the state, the study also explores possible roles that traders can play in sustainable use of fisheries resources. At present, because of lack of refrigerating facilities in Cambodian side of the border, all the fishes had to be rushed to the Thai side. By regulating fish amount to flow to Thailand with low price, and coordinating with fishers, border traders can be a key player in avoiding over-exploitation of fisheries resources in Tonle Sap. Women traders, being in direct contact with the fishers and middlemen, as well as with Thai traders, can play a significant role in fisheries resource management. The role of women border trader can give us a hint in how effectively traders can contribute to resources management, and in reverse, the state's recognition of their role in fisheries resource management can lead to changes in the women traders' relation with the state.

UNDERUTILISED MEDICINAL MARINE PLANTS AS RESOURCES FOR RURAL WOMEN'S DEVELOPMENT IN THE SOUTH PACIFIC

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There are perhaps one hundred marine plant species in the South Pacific that may be used either as food or for medicine. These include a number of species that are large and common enough to sustain careful harvesting for small-scale commercial applications. *Eucheuma,* a seaplant that is widely grown as an aquaculture product in Pacific Island coastal communities, also has many food and medicinal applications.

Women in rural coastal communities traditionally are responsible for family health and nutrition, and many have extensive traditional knowledge of the use of medicinal herbs, roots etc. Although traditional knowledge and use of marine medicinal plants is well developed in Asian countries such as China, Japan and the Philippines, peoples of the South Pacific largely ignore this source of medicines. Research performed in 1999 revealed that in many Pacific Island countries, people have scant knowledge of marine plants as food or medicine. In some cases atoll dwellers suffer nutritional deficiencies that could be alleviated by the use of edible marine plants as vegetables. In many cases, there are unrecognized opportunities to develop cottage industries for the manufacture and sale of seaplant products.

Modern science has shown that many marine plants do have valuable properties, especially for prevention of the "modern lifestyle diseases" such as heart disease, diabetes and cancer. In recent years, with assistance from the Canada – South Pacific Ocean Development Program, I have undertaken research and development of edible and medicinal marine plants at the University of the South Pacific, in collaboration with local non-governmental organizations.

In this paper I will outline some of the properties of common medicinal marine plants and how these are being used to develop small businesses. Such businesses are particularly well suited for women; they hold promise for local economic development and affordable, preventative health care.

THE INVOLVEMENT OF FEMALE LABOUR IN SEAFOOD PROCESSING IN SRI LANKA: IMPACT OF ORGANIZATIONAL FAIRNESS AND SUPERVISOR EVALUATION ON EMPLOYEE COMMITMENT

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The expansion of export production of fish has been associated with the feminization of the fisheries labor force. This paper specifically attempts to address the women's role in the fishprocessingector. The impact of organizational fairness and supervisor evaluation perceptions on worker's commitment were the central theme. Data were gathered from a 35-item questionnaire based on the 7 point Likert scale questions. Randomly selected 50 female workers from 10 seafood processing firms located in West and North-west provinces of Sri Lanka were subjected to assess their fairness perceptions, evaluations of their supervisors and commitment levels. The impact of organizational justice and supervisor evaluation scale on the employee commitment was analyzed by using hypothesis testing. The results showed that female domination in lower grade jobs was high and the male to female ratios was 2:10 in prawn plants and 4:10 in tuna plants. But in quality control and administrative grades the ratio was 2:1 and top management positions were held overwhelmingly by males. The majority of the women employed were in the age range 25-29 years, unmarried and having completed their secondary education. Results of the multiple regression analysis indicated that the effect of fairness was a significant predictor for organizational commitment. The correlation between commitment and supervisor evaluation received highest positive value. Perceptions of the supervisor had important impacts on commitment. The decision-making structures allowed little room for a gender perspective and women's participation in trade union activities were low. Women regularly performed majority of the processing tasks in the shore fishery (common in west and northwest coasts but rare in southern coasts). The range of tasks they performed in the frozen fish production process was more limited. Men predominate as filleting, skinning and boning machine operators, hand cutters, freezer operators and cold storage operators in Tuna processing. The jobs where female predominate were weighing, grading, packing and trimming and these were the lowest paid occupations in the plants (average monthly salary was US$48). Employment in fish processing sector provides women with some degree of economic autonomy, improved status and influence within their households. Knowledge gained from experience, based on previously existing high levels of education, varied skills and expert judgment are critical assets of Sri Lankan female labor. The common appreciation that women's role in the seafood processing plants was constrained by their domestic functions and multifunctional role conflicts. Seafood processing industry opens up a new avenue to Sri Lankan women to redefine their position in fishing communities.

ALTERNATIVE LIVELIHOOD OPTIONS FOR FEMALE WORKERS IN SHRIMP PROCESSING INDUSTRIES OF BANGLADESH

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In response to expanded global demand for high quality seafood Bangladesh has in the recent past witnessed an enormous growth in shrimp culture and processing making it as the second largest export earning sector of the country. In shrimp processing industry female workers are active in harnessing the enormous growth of this sector. Their involvement is very wide starting from fry collection to shrimp packing for onward export. With an average earning of only $50 a month against the poverty threshold income of $132, the women can hardly maintain a minimum livelihood. The present study was carried out to understand the socio-cultural and economic conditions of female workers involved in shrimp processing industry with an ultimate objective of identifying alternative income sources for their sustainable livelihoods.

The study was conducted at several shrimp processing areas under Khulna district through group discussion and semi-structured questionnaire. The female workers were found to be very poor and illiterate having no formal training on shrimp handling and processing. Most of them are hired on temporary basis without any contractual agreement. Their main activities include processing, standardization, grading, sorting, and washing of processed shrimp. Due to the prevailing gender inequality, the female processors are getting less than their male counterparts while facing different social problems for being involved in this sector. Most of the female workers showed keen interest in using shrimp waste products for the development of value added products including shrimp crackers and sauce provided they have the right technologies and necessary help from other organisations. It was observed that while freshwater giant prawn (*Macrobrachium rosenbergii*) heads are being used to some extent for human consumption and catfish feeding, the black tiger shrimp (*Penaeus monodon*) heads are almost completely disposed of in landfills or into the river. The primary reason for the limited utilization of the waste is its highly perishable nature. Under humid and high temperature conditions decomposition of the waste occurs even more rapidly. The waste quickly becomes colonized by spoilage organisms and is rapidly transformed into both a nuisance and public health hazard.

Being involved with shrimp sector over the years, most of the women have structurally changed their profession from a traditional one such as home gardening, duck/poultry rearing, maid servant etc. while lack of market access is further complicating any possible alternative. In this regard, value addition to shrimp processing wastes might provide extra income to the women processors. A new micro credit service system solely aimed at the female workers involved in shrimp processing sector should be set up to facilitate implementing such alternative livelihood options and a proper marketing channel for the resulting products should also be developed.

WOMEN'S PARTICIPATION IN TRADITIONAL FISH PROCESSING: EXPERIENCE OF PROSHIKA UNDER CBFM IN VILLAGE DASPARA, KULIARCHAR IN BANGLADESH

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Bangladesh is a land of rivers, ponds, *haor-baors*, *khals-beels* and floodplains. The villages of Bangladesh are situated in the bank of rivers, *beels* and floodplains. The fishers are engaged catching the fish from rivers, *beels, haors-baors* and other water-bodies area. The women of the fishers are engaged mainly in household works and fisheries related activities viz. washing, removing viscera, salting, drying, packing, fermenting (make *shidal*) of fishes.

Proshika has started Community Based Fisheries Management (CBFM) activities in Kali *nadi* since 1996 with collaboration of WorldFish Center and Department of Fisheries (DoF). Daspara is a Hindu fisheing village. It is situated in the west bank of the Kali *nadi* in Kuliarchar *Upazilla* approximately 120 km northeast from the capital of Bangladesh. There are about 300 households within the village and about 90 percent are Hindus communities. Traditionally Hindu communities have been mainly engaged in fishing. The women of the village have been engaged in traditional fish processing for two decades. They borrowed money from *mahajans, aratdars* as an exorbitant rate for this purpose.

From 1996, Proshika has provided credit to women of Daspara village for running their traditional fish processing practices after started the CBFM related activities in Kali *nadi*. About 459 women received Tk. 27.67 million as credit from Proshika for running the fish processing activities e.g. drying & fermenting (make *shidal*) in environment-friendly manner. Proshika provided training to 281 women in fish processing & marketing, group development & credit management related aspects. The women are drying their fish in *Dungi* or bamboo platform and fermenting fish (make *shidal*) in *Motki*. This way each woman can earn a net profit of Tk. 2000-2500 per month after selling their processed fish in the market besides their household activities. Nowadays, women have been playing decision-making role in the family. Their children go to school. They are now free from exploitation by *mahajans* & *aratdars*, their livelihood also changed.

SELLING FISH IN TARAWA, KIRIBATI

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On the urbanized island of South Tarawa in Kiribati, a population of more than 36,700 people resides on a land base of only 15.8 square kilometers. The people depend greatly on fish and shellfish for protein. Both men and women are active fishers, with women focused on shallow lagoon and inner reef habitats while men predominantly target outer reef edges and deeper water fisheries. Shellfish are harvested and sold predominantly by women. Fish that are harvested by men are also sold by female fish vendors. Thus, women's work in handling and distributing marine products is critical to the food security of Tarawa.

This paper will explore the work conditions, supporting infrastructure, legal framework and workers' attitudes in the fish trade of South Tarawa.

Information for this study was collected in 2003 through structured interviews with female fish vendors and others involved with the fish trade (e.g. fishery officer, fishing business owner, municipal council staff, municipal councilor, Kiribati Provident Fund staff).

In the past, fisheries products were shared among families or sold door to door. Today, fish vendors working for their families or for fishing enterprises cluster on roadsides in particular places where customers congregate. Although municipal councils and foreign donors have collaborated to develop several fish markets, these are poorly sited and insufficiently developed to suit the needs of the fish vendors.

Female fish vendors of Tarawa are often poorly educated. They have no or few employment possibilities. The fish trade is tenuous and poorly paid; in some cases women work long hours and are not paid at all. Even when they are exploited by their employers, vendors feel that they cannot risk complaining about their poor pay and work conditions. In general the women are unaware of their labour and civil rights. None of those interviewed was aware of Kiribati Provident Fund, which could provide them with some security and insurance.

The fish vendors' working conditions are often difficult and unsanitary. Although they are responsible for keeping their fish clean and fresh, they lack the training and infrastructure support to do this. With its dense and rising population, South Tarawa faces serious environmental challenges, especially household waste and sewage management as well as overfishing, which have negative impacts on womens' inshore fishing grounds. The fact that there are few women on municipal council, in the fisheries department and in the fishing business means that female fishworkers often lack empathetic advocates on decision-making bodies. Their needs and concerns are not addressed, nor are women empowered to help to deal with the problems in the marine environment, fishery and fish trade.

This action research hopes to stimulate concrete action to advance the rights, capacity and well-being of fishworkers.

GENDER STRATIFICATION IN FISH PRODUCTION SYSTEMS: WOMEN DO HAVE ECONOMIC POWER

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The small-scale fisheries sector in island communities is generally male-dominated. The case of the island-town of Limasawa in Eastern Visayas, Philippines is characteristically traditional in its fish production systems. The technologies, methods and practices of fishers have not significantly changed as compared with the urban counterparts. Inherent in this structure comes certain perceptions and practices which define women's economic participation as a "helping-out" role, considered part-time and unpaid family labor, and work which is an appendage to men's. In this scenario, do women still have economic power?

This paper looks into the nature of gender stratification in fish production systems vis-à-vis the extent of economic power that women are able to mobilize. Using Blumberg's Gender Stratification Theory, the position of women relative to men is identified along the following discussion points: the extent of women's economic participation in fish production, the strategic indispensability of women's labor supply, and women's ability to mitigate the "discount" rate.

Forty fishers' wives were randomly selected in three out of the six coastal villages of Limasawa. A survey questionnaire was administered. Focus Group Discussions were also conducted in order to probe into matters that the survey is unable to capture.

Research results show that fishing households in Limasawa live at the borders of the bountiful Pacific Ocean and the Sogod Bay, yet are generally poor and marginalized. Household income from fishing is low and comprises more than half of total monthly family income which is only about US$53.21, way below the poverty threshold. Women's contribution to family income is lower, ranging from US$8.25 to US$22.12 per month.

There is gender discrimination in fish production systems. Specific work spheres are relegated to men or women according to accepted norms based on gender. Women's work is concentrated in the preparation stage for a fishing trip, and the post-harvest. Many of these are unpaid, hence, no cash incomes may be brought home by the women. However, these works are indispensable in the whole fish production system. Women can work autonomously without male supervision, and women control some technical expertise specially in fish preservation and marketing. This strategic indispensability of women's work, in addition to women's actual participation in fish production, is a source of economic power.

The nesting of economic power is indicated by the "discount rate," that is, the extent to which women's economic power is reduced or enhanced depending on whether this economic power is concentrated in the micro (household), or the macro (communities) level. Women in Limasawa have, in the recent past, been able to widen their work spheres, and to expand the uses of their time beyond the household. The demand for women's labor in alternative economic activities boosts the "discount rate."

Women, amid the traditional coastal fishing industry, are able to translate their economic participation into their ability to control their own productive activities, and the corresponding distribution of the outputs of their productive activities.

GENDER STATUS IN INDIAN FISHERIES EDUCATION, RESEARCH AND DEVELOPMENT ORGANIZATIONS

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In India, with more than 50% of the one billion people depending on fish as an important source of protein, heavy emphasis has been placed on the fisheries sector. Establishment of institutions dedicated to fisheries education, research and development started since independence. The first professional fisheries degree program in fisheries started in 1969 under the Agricultural University System. Today, there are twelve Fisheries Colleges established under different agricultural universities located in different states and a National University on Fisheries under the Indian Council of Agricultural Research (ICAR). These colleges have the primary responsibility of training the manpower required for the Fisheries Sector. In the field of research, there are seven National Fisheries Research Institutions dealing on different aspects of Fisheries. Almost all the states now have a separate Department of Fisheries with the assigned primary task of developing fisheries.

Fisheries Colleges so far have graduated more than 3000 persons, but the number of female graduates is only about 18%. However, this small number of women with fisheries degree has spread in to all spheres of fisheries and is making significant contribution. Although in Fisheries Colleges, no special emphasis is placed to reserve seats for girls, in some states like in Kerala where literacy rates are highest, almost equal number of male and female students has been graduating every year. Surprisingly, in some of the Fisheries Colleges female students are not admitted because of lack of hostel facilities. With the change in recruitment rules to recruit only professionally qualified fisheries graduates, with no female graduates passing out from some of those states, gender inequality in terms of staff strength is already a major issue.

In the Research institutions under ICAR, among more than 500 scientists working in various fisheries institutions, only about 14% are women. Some of them have reached senior positions. The Central Institute for Brackish water Aquaculture was once headed by women, who was the first Director of any ICAR Fisheries Research Institute in the country. Currently, after retirement she continues to be active in the Fisheries sector through involvement in various programs, including running a Non-Governmental Organisation. The contribution of women working in various Research Centres is reported to be good in terms of research output. The institutions recognize the contribution of these women scientists as they have in most cases the dual responsibility of maintaining family as well as attending to office duties. In view of this dual responsibility, they are some times not able to participate in programs that demand their presence from their normal working area.

Most of the State Fisheries Departments Technical divisions are dominated by men and only in recent times, women have begun to enter the technical divisions. Some states are completely devoid of female technical staff. State Departments are responsible for Fisheries Development; the absence of female staff both in technical and policy levels has created gender inequalities in various field base development programs.

This paper presents the current status of gender in three major wings of fisheries, namely education, research and development. The perceptions of administrators, staff and fishers about gender issues and the strategies that could be adopted to bring gender equality over a period of time are discussed.

GENDER MAINSTREAMING IN MEKONG FISHERIES: FROM POLICY TO PRACTICE

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Since 1995, the Mekong River Commission (MRC) aims at ensuring equitable allocation of power and resources to women and men to define participate in and benefit from the development in the Mekong, in accordance with their particular needs and interests. Due to inequalities affecting women in all sectors (e.g. reduced educational opportunities, lack of technical expertise, gender-insensitive training, difficulties in access to finance, landlessness, domestic violence, etc.), a fully gender-mainstreamed approach in the development of the Lower Mekong Basin (LMB) requires an emphasis on women-specific activities.

For the Fisheries Programme of the Mekong River Commission (MRC/FP), "entry points" for gender and women in fisheries are: 1) considering gender in programme formulation and organization within MRC/FP; 2) examining gender roles and opportunities in fisheries, with a view to deal with gender and women related issues in an adequate way; 3) addressing women's practical and strategic concerns and priorities; and 4) communicating and networking "gender and women in fisheries".
The following are among the experiences made by MRC/FP in implementing these "entry points":

1) Based on MRC's Gender Policy and Strategy, and encouraged by the main donor (Danida), women at all levels are involved in programme formulation; furthermore, women involvement in programme activities and participation in benefits is measured in a gender-disaggregated way; and programme activities and procedures are analyzed to determine if they are helpful for women. While a lot has been done, the programme's objective of equal participation has not been realized so far.

2) Studies conducted by MRC/FP have not only confirmed women's involvement in fisheries in the Region, but is has shown that women's involvement may be higher than that of men; furthermore, involvement is not only in fishing, fish processing and collection of non-fish aquatic products, but also in fisheries management decision-making. There is a need to make these multiple roles of women in fisheries visible.

3) Women's practical and strategic concerns in fisheries are interrelated and frequently cannot be clearly separated; for example, increased income from fish-related activities as a practical concern may have a decisive impact on liv elihoods, property rights and women's standing in the community that is, strategic concerns;

4) MRC/FP has supported the regional Network of Women and Gender in Fisheries (NWGF), since its inception in 2000. While it is still largely a network of women staff in fisheries agencies, its membership comprises academics working in gender studies, and future participation by women from grassroot organizations is being contemplated. Furthermore, the Network was given observer status on Technical Advisory Body on Fisheries Management, a regional organization advising governments on policy issues in Mekong fisheries.

A STUDY OF WOMEN FISHERS EMPOWERMENT IN DIFFERENT LEVEL OF CO-MANAGEMENT PROCESSES (CMPS) (A CASE STUDY IN FISHING COMMUNITY IN PEMALANG AND DEMAK REGENCIES, CENTRAL JAVA - INDONESIA)

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In general, women play three main roles (reproductive, productive and managing community) in their community. Many evidences showed that women`s contribution to their family and community are significant particularly in the developing countries but also reported in the developed countries (plenary of women session, IIFET Conference, Japan, 2004). The study aims to answer the research questions: (1)how significant is women contribution to their family and community?; (2) in what extent women are power-less; (3) does co-management approach help to improve women's empowerment?. 60 persons for each study area were interviewed. The quantitative approach was employed to analyze the data collected from the field. In addition, qualitative description was also applied to support the analysis. The results indicated that women were widely acknowledged playing important roles in informalways, especially in sustaining their household needs. In this extent, women have been empowered. However, towards the external activities or arrangements such as lobbying and decision making etc. the place of women is taken over by men. The sense of belonging and understanding among stakeholders is needed in order to improve the roles of women fishers and their empowerment. Then, co-management approach perhaps could be selected as the suitable approach.

RESPONDING GENDER AND DEVELOPMENT ISSUES IN COASTAL AREAS: LESSONS LEARNED FROM PANGANGAN ISLAND, CALAPE, BOHOL, PHILIPPINES

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Pangangan Island of Calape, Bohol consists of eight barangays (villages) with fishing as the main source of living. The island is one of the areas proclaimed as Protected Areas. The island is also the project site of the Coastal Environment Program of Community Environment and Natural Resources Office (CENRO) Tagbilaran City since 1994. It is also one of the community -based project sites in Region 7 where the Gender and Development (GAD) mainstreaming program of the Department of Environment and Natural Resources (DENR) was piloted in 1996. In 1998, Pangangan Island Coastal Environment Program was awarded the "Most Gender Responsive Project "during the Search for DENR National GAD Service Award. The impact of its mainstreaming was assessed using semi-structured interview with key informants and Focus Group Discussion (FGD) with at least five representatives from the eight people's organizations (POs) of the island.

The results revealed that membership of the POs have expanded from 383 to 451 with 239 males and 212 females. In terms of access and control of resources in the island, before GAD mainstreaming, there was bias in favor for men. Today both men and women have equal opportunity to access these resources. Capital and Income accumulated by POs totaled ₱314,598.50. This income has increased to ₱ 556.370.25 after they won the award due to expansion of projects. As to seminar and trainings conducted and attended by PO members, men have higher percentage of attendees compared to women. There has been an increase in women's and youths' participation particularly in accessing credit, rice trading, hog dispersal and food for the family. As to linkages and partnerships with other institutions, men outnumbered the women in participation. However, after mainstreaming and receipt of award, the participation of women was doubled.

LOOKING FOR WOMEN IN PHILIPPINE FISHERIES POLICIES: RESEARCH TO DETERMINE ADVOCACY POINTS FOR FISHERIES

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Laws present many possibilities and potential pathways for women's alternative views and visions for themselves, their families and society". (Reyes & Valdeavilla, National Council for the Role of Filipino Women). The Philippine government is a signatory to various UN conventions and declarations to uphold women's rights and address gender inequalities. As early as 1975, the government has passed several national policies to adopt a development plan for women, to allocate for gender and development budget, to address issues on violence against women etc.

In the Agriculture and Fisheries sector, government studies and documents have recognized women's invisibility. Despite the government's policies and affirmative actions on women and gender issues, a study conducted in 2003 showed that there were no concrete actions through policy or programs and projects that address women's issues in the fisheries sector. Various documents of government agencies involved in women and gender and in agriculture and fisheries were reviewed. These documents consisted of laws and policies approved at the national level, programs and plans on women and on the fisheries sector, and policies/ordinances, development plans and services of two municipalities in Region 8 in the Visayas region. Semi structure interviews and focus group discussions were conducted for the preparation of two case studies featuring two municipalities where CERD implements its community based-coastal resource management program. Results of the study were presented in a validation workshop attended by leaders of organized women fishers from the three major island of the Philippine Luzon, Visayas and Mindanao.

The validation workshop also paved the way for the identification of women and gender issues in the Philippine Fisheries as well as ten key actions points. These action points are: Approval of the Magna Carta for Women wherein women fishers are already recognized apart from peasant or women farmers; ensure seats for women fishers in the Local Sectoral Representative (LSR Bill) and 30% of the Municipal/City Fishery Aquatic Resource Management Council (M/CFARMC) representatives should be women. One seat should also be given to women fishers in the National FARMC. Actions to address fisherfolk settlement issues should include women. Promulgate program and ensure GAD budget allocation for women fishers. Recognize and deputize women fishwardens. Establish centers for abused women and children. Stop dumping of waste in coastal areas and promote proper solid waste management. Children of fishers should be granted scholarship and other educational support. These action points were already presented during the Rural Women Congress where the leaders from the women fishers group participated. The Congress adopted these action points and incorporated in their plans. In the subsequent regional consultations and meetings of the Rural Women Congress, women fishers have been invited. They also participate in dialogue and lobbying activities to push for the final approval of the Magna Carta as well as follow up government agencies concerned with addressing the issues and plans identified during the Congress.

The struggle of women fishers to be recognized and be heard has finally started bearing fruits. Several avenues have been opened to them. Realization of their dreams is just starting to materialize. Efforts to capacitate themselves, to learn, to negotiate and dialogue not only with government agencies but also with partner fishers have to be sustained.

EUROPEAN FISHERWOMEN CONTRIBUTION IN FISHERIES AND ITS LEGAL RECOGNITION

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European women participate actively in fisheries and aquaculture sectors. Women's contribution is more important within small scale enterprises in both sectors. It must be noticed that the great number of European fishing boats and shellfish aquaculture vessels is constituted by small scale units. In this case women's work is important for the survival of the family and of the enterprise. Within this type of enterprise women accomplish different functions: they can be directly involved in the production (fisheries and aquaculture), or in mending of nets (Spain, Greece, and Portugal), selling fish or shellfish (France, Portugal, and Spain), processing fish (Finland, France), operating restaurants, etc. Nowadays women are also responsible for the management and the administration of their husband's enterprise.

Women's contribution is rarely paid and never appears in statistics. Their work remains informal and without legal recognition. In 1986, a European Council adopted the Directive 816/613/EEC on "*the application of the principle of equal treatment between men and women engaged in an activity, including agriculture, in a self-employed capacity, and on the protection of self-employed women during pregnancy and motherhood*". This directive asked member states to recognise spouses' contribution within self-employed activities and aquaculture. Fisheries and aquaculture can also be included in the category of self-employed activities. Few years later, European fisher women claimed to national authorities for the legal recognition of their contribution. Some of the European Union members states, like France, recognised women's work. But until today, only a few of them adopt this status. From 1997, French women pay, if they wish, social and pension contributions. In this presentation we will present the tasks realised by women and develop the issue of the legal recognition of women contribution within European countries.

WOMEN PARTICIPATION IN FISHERIES ACTIVITIES IN MANIPUR VALLEY IN INDIA WITH TRADITIONAL FISH BASED BELIEFS AND CUSTOMS

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Manipur, a land-locked state on the Northeastern part of India is known for its rich fishery resources through the well-known Loktak Lake and several other forms of freshwater fishery resources. The dependence of valley population on fish is so high for generations, several fish based beliefs and customs are commonly noticed. Active participation of women in capture, culture, processing and marketing activities is witnessed throughout the valley. Unlike the rest of India where women movement and activities are restricted, in Manipur such restrictions are not commonly seen. The environment prevailing in Manipur is similar to that commonly seen in some of the Southeast Asian countries.

In the capture fisheries sector, activities that do not require greater body force like angling, Chinese dip net usage, and operation of small drag net, etc are carried out commonly by women. In the aquaculture sector, which is now emerging as a major activity with more than 5000 ha water area under the activity, participation of women from digging of pond to marketing of fish is common. There are special programs that have been formulated to promote the interest of women in aquaculture. In the processing sector, wherein fish are preserved by using various methods like drying, fermentation, etc., participation of women is commonly seen. In the marketing sector, women dominate with some markets being declared as "All women market. There is also a high degree of respect for women and as such their movement is not affected. While the existing traditions have allowed more opportunities for women, they have also added more work burden to them with household responsibility being almost entirely with women. Those women involved in marketing travel long distance in odd hours to reach the marketing venue at the right time. With frequent declaration of strikes by various groups in the valley, women are the most affected.

In terms of beliefs and customs, from birth until death, fish is always associated in various ways. Snakehead group of fish *Channa orientalis* is released into the water on the sixth day of a child's birth with a prayer for its well being. On the first day of marriage, couples are fed with a dish made exclusively from the fish *Acanthophthalmus pangia*, which is locally called "nganap"; it means sticking fish with the belief that the couple remains inseparable for life. In various festivals celebrated, fish preparations are essential and the biggest festival celebrated annually called "Ningol Chakouba" is an occasion when the parents invite their daughters for the grand celebration of the festivals with several varieties of fish preparations. When a person is sick, live fish are released into the water with a prayer to take away the illness. After death, fish is not consumed until the ceremonies are completed.

Although, women are better placed in this valley as compared to other parts of India, there are many gender issues that need to be addressed. This paper attempts to highlight the positive issues that are useful to improve the position of women in other regions, while highlighting those issues that need to be addressed in the state to improve the position of women further.

WOMEN AND FISHERIES IN BANGLADESH: LEVEL OF INVOLVEMENT AND SCOPE FOR ENHANCEMENT

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Bangladesh is a country with huge water resources in the form of small ponds, beels, lakes, canals, small and large rivers and estuaries. Both men and women are involved in fish production in Bangladesh. Women in fishing communities play an important role. In Bangladesh, little research has gone into the question of how fisheries affects the status of women and gender relations in the household and the community, and how in turn these relationships influence the effectiveness of aquaculture in improving livelihoods and addressing poverty. The main objective of this study is to assess the strengths, weakness, challenges and constraints women encounter while participating in various fisheries activities. Other goals are to review existing aquaculture/fisheries policies from a gender perspective and gender interactions within the sustainable livelihood framework, identification of existing social and cultural practices that create hindrances to women's participation.

This paper focuses on the women's involvement in fish production and has assessed the involvement of women by reviewing five projects in Bangladesh sponsored by DFID Bangladesh. The findings presented in this paper are based on case studies, Focus Group Discussion (FGD) and semi-structured interviews. The findings reveal that most of the projects have involved men as full time while women's role remains in most cases insignificant. Nevertheless, women in three projects are directly or indirectly engaged in activities like making fish nets, gears, preparing fish feed, fish processing, digging of ponds and fingerlings sorting. Women in some areas are also found to be involved in catching fish, transportation, marketing, etc. However, still these women do not have any representation in the management and decision-making process of the fish production processes. Most women are taken as beneficiaries but not as active participants. Moreover, women in fisheries do not have access to physical and capital resources. This paper will argue that if women are provided access to these critical resources and participation in the planning, design and management, it will not only improve fish production efficiency, profitability and sustainability of their activities but will also enhance women's socio-economic and political status.

VALUING LOCAL KNOWLEDGE IN THE CANADIAN ARCTIC: HOW THE INVOLVEMENT OF LOCAL PEOPLES RESULTS IN RELEVANT RESOURCE MANAGEMENT DECISIONS

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Many Arctic communities are dependent upon fisheries for food, employment and cultural and spiritual sustenance. Yet, globally, marine resources are being depleted or over-exploited. Sustainable development in the Arctic depends on democracy in decision-making processes that affects the management of natural resources. This is supported by international agreements including the Rio Declaration on Environment and Development and Agenda 21. In particular, the Johannesburg Declaration on Sustainable Development emphasizes gender equality and the role of indigenous peoples in achieving sustainable development and specifies that sustainable development: "requires broad-based participation in policy formulation, decision-making and implementation at all levels".

Following the 2002 Gender Equality and Women in the Arctic Conference in Finland, the Northern Feminist University in Norway initiated the "Gender and Decision – making in Arctic Fisheries Project". This project was supported by the Arctic Council which is an international organization comprised of the eight circumpolar nations. The "Gender and Decision-making in Arctic Fisheries Project" involved Canada, Norway, Iceland, Greenland, Sweden and the Faeroe Islands. This paper presents the results of the Canadian project. Specific objectives of the Canadian project are:

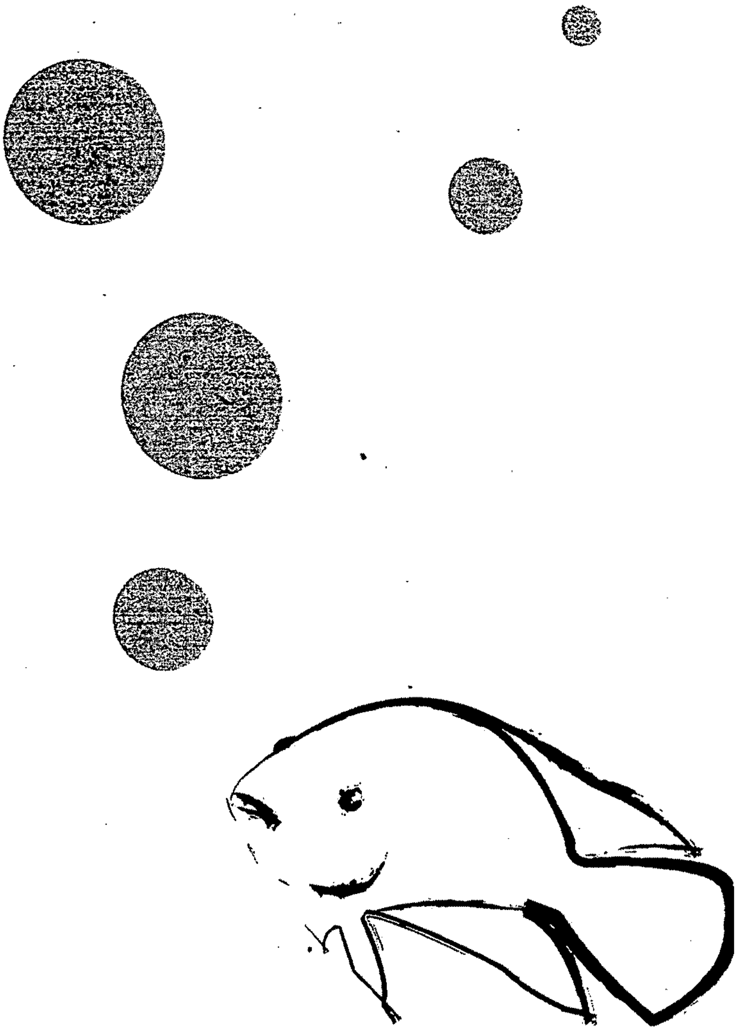
1. To document the distribution of Inuit women in decision-making roles in Arctic fisheries.

2. To document Inuit women's contributions to Arctic fisheries and identify barriers to a more significant participation in all aspects of the fishery.

3. To develop a strategic action plan to mobilize Inuit women and to increase Inuit women's access to and participation in decision-making processes related to Arctic fisheries.

Project results will benefit northerners and northern communities through identifying the causes of the limited participation of women in decision-making processes in Arctic fisheries and developing measures to redress this situation. The project contributes to identifying problems and makes recommendations for further action at national and international levels. The Canadian project establishes a knowledge base that can be used for promoting gender equality in decision-making processes of the marine sector throughout the Arctic region; developing tools and strategies that can used to encourage participatory values and practices and promoting international cooperation on issues relating to women's participation in fisheries. Further participation will contribute to the continued democratization and sustainability of Arctic fisheries.

SS Fisheries Co-Management



WOMEN'S ROLE IN COMMUNITY BASED FISHERIES MANAGEMENT PROJECT-2

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The women are half the total population of Bangladesh. So, the women can make huge contribution to the development program of the country and nation. As long as the women are not taking part in the development work there can not be much progress in the national development.

Considering the potential of women the CBFM-2 project has undertaken various direct & indirect development program, where women are getting emphasis & participating to achieve the project goal. Such as, women are working in fisheries resource management like, they formed the open water body management committee (BMC), took training on fish culture, participated in habitat restoration program by digging off silted open water bodies alongside participated in various income generating activities which has uplifted their livelihood by creating a source of extra income, participated in construction & maintenance of sanctuary for natural fish conservation, timely harvesting & selling fish to the buyer. Apart from these, there are few traditional approaches which have been practiced for centuries by the women fisher folk. Like, making nets, preparing fish-feed, taking care of nursery pond & ensuring the nutrition of the family specially the children.

Research Finding (Few stories in CBFM-2 field)

Banchte Shekha is one of the women lead PNGOs in CBFM project -2. We have captured in one of the stories in Maliat Beel in Narail that, women beneficiaries are not only involved in the fisheries management. Moreover, they are working as community leader to advocate & solve problems regarding women's right, injustice towards women especially domestic violence, dowry, polygamy, divorce. They have already been successful in few cases & they have created their acceptance from the community to the UP chairman along with other elites in their village.

In BRAC field we found that, women are involved in silted open water body digging & earning money. In Ruhis Baisha Beel we captured a story on Sreemoti Shadhana Rani. She stated that she knows the benefit the community will get through the digging work & she can also contribute to her family with her earning. She now has the decision making power in her family & she does not bother about the backdated concept of local people specially the conservative people who are not used to seeing women in such non traditional work. She also said that her husband is a fisherman. He can't catch fishes all though out the year. After her involvement in the project she can maintain her family quite well.

We found another story at Ashura Beel, Caritas, Dinajpur. There is a wife of a fisherman; she shows how she is ensuring the nutrition of her family by eating small fishes. She may not be directly involved in fisheries management but she is playing an important role in ensuring the fish protein & nutrition for her family.

In another very interesting story of women's group, CNRS, Magura, we find, these groups took the fish case culture based training from CNRS & they are now cultivating fish in cases in Fotki River, Magura. No doubt, this is an outstanding new approach, an effort taking by CNRS for women.

We believe, this will be a model for involving women in fisheries sector, that, how fish can be cultured in open water bodies all year round.

Conclusion

We have taken the oral testimony of the beneficiaries, each story teller's interview with the cross interview of the concerned officer of the PNGOs. According to the stories, FemCom felt that if 50% of the national population is women then 50% of the fisher folk community should be involved in the fisheries resource management so that the ultimate goal of the CBFM project can be achieved quickly.

DIFFERENT APPROACHES OF COMMUNITY BASED FISHERIES MANAGEMENT: PROSHIKA EXPERIENCE IN BANGLADESH

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Bangladesh is a riverine country. Many rivers, *beels,* flood plain *beels, khals, haors & baors* are situated in Bangladesh. About 4.04 million hectare area are covered by these resources. These common resources have used by different stakeholders. Proshika has been working with fishers community in *beels*, flowing rivers and other open water body for a long time. Proshika believes that without the fisher organization these common resources are not being used properly by fishers and other poor people. In Bangladesh, maximum *beels*, flood plain *beels* & rivers are used by influential people and the fisher community is used by them as a daily labor. To establish the fishers access right to the water body, ensure sustainable and equitable management approaches, Proshika has implementing the Community Based Fisheries Management phase-2 (CBFM-2) project with collaboration of WorldFish Center, Department of Fisheries (DoF), funded by Department For International Development (DFID) since 2001. Proshika has implemented this project within 21 water bodies which are flowing rivers, *beels,* flood plain *beels* and *khals.*

To establish the access right in the water body by fisher communities and others who are directly involve in common natural resources for their livelihood. Communities people in each water body formed a management committee which is called *Jalmahal* Management Committee (JMC) or water body management committee from different types of stakeholders. The committee has to lead community based management approaches which are implementation process & activities, identification of different issues and plans for aquatic resources management. To identify the management process and fisher community status to improving better management the committee plays an important roles & responsibility. Some area the local govt. representative, local elites and other stakeholders are included in management committee. Proshika has formed 21 JMC in 21 water-bodies. The name of the committees is called on the basis of water bodies' type viz. Beels/Rivers/Khals management committee. Each committee consists of 15-30 members representative of the water bodies. Proshika has applied different approaches to organizing the communities for managing the water body. The approaches for formation of JMC are only genuine fishers; all types of fishers; fishers and other stakeholders; fishers and local elites; fishers, local govt. representative and other stakeholder. Local govt. representative and local elites are involved as a advisor in these committee. For proper implementation of CBFM-2 project activities through community participation the approaches for formation of community-based organization would be differ on the basis of opinion of all level stakeholders.

COMMUNITY ENTERPRISE ON FISHERIES FOR SUSTAINABLE AND EQUITABLE DEVELOPMENT IN FLOOD-PLAIN AREA- A POVERTY REDUCTION STRATEGY

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The farming community, comprising of sixty percent population of Bangladesh, is becoming gradually poorer and isolated within the community. It is a result of a joint conspiracy of the influential people and lack of good governance in the rural community system. The general unorganized people are only somehow existing.

Development Concept

Without creating discrimination in community, using properly the unused or less used wide probable manpower, lands and water, community based fisheries project can be established. Through this way sustainable socioeconomic development can be able without any out side support or liability of credit on shoulder to alleviate poverty, make employment opportunity, increase of per capita income, assure food security and establish good governance.

Community based fisheries program is not only the fisheries development in community. In this program maximum participation of community and empowerment system through proper management of local resource get most importance. It can be bring back the poor part of the community in mainstream of development, establishing their ownership maintaining equity. This system increases the self-dignity of people in the community. Thus the backward, land less, rich and poor, all categories of people can take part in the management of the project and implement sustainable socioeconomic development.

Lesson learnings

To bring the concept into reality SHISUK has been implementing a model program since 1995 in a flood plain area where more people are depended on their land and water. The concept has been recognized by the ministry of Fisheries and Livestock as a model program in 1999 and awarded SHISUK the National Gold medal. With the cooperation of DOF and World Fish Center SHISUK is implementing another community based fisheries project under the project CBFM-2. Beside of it 105 community based fisheries projects has established as a demonstration affact in the neighbouring community. To spread the success of such programs over the country department of fisheries has taken wide program for total flood plain in Bangladesh.

Prospect

There are 28.33 hectors of flood plain lands in Bangladesh. 50% of this land is potential for such fisheries. On going fish production rate in flood plain can be increased from 0.15 MT/Hector to 1.5 MT/Hector. Simultaneously preserving natural species of fish its production can be increased in 0.2 MT/Hector. Along with economic gain by the people, a self-reliant and healthy social structure can be made by eradicating poverty, making employment opportunity and establish good governance at the community.

AN ANALYSIS OF CO-MANAGEMENT ARRANGEMENTS: CASE OF A FISHING DISTRICT IN FIJI ISLANDS

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Korolevu-i-wai, a district in the province of Nadroga, Fiji Islands is inhabited by approximately five generations of residents. The initial migrants, who were largely from the interior part of the main island, did not have a clear tradition of fisheries management and an indigenous expertise on fish stock management.

The district residents recall that until the late 1970s, there was abundance of coastal resources and lack of resource use conflicts. The scenario began to change in the 1980s due to two events: 1) development of tourism activities along the coast in the district. 2) commercialization of the once subsistence fisheries. Together, these events progressively devastated Korolevu-i-wai fishing grounds. They also gave rise to conflicts over fishing activities in the district.

In the late 1980s, the effects of fishery depletion and unabated destruction of coral reefs began to be felt. Increase in population, coupled with the rapid decline in fish stocks over the past decades, subjected the fishery resources to further stress. The worsening resource situation was closely linked to unsound fishing practices, ignorance of the concerned institutions in stock management, and the existence of stakeholders, who sometimes supported unsound fishing practices.

The Community Based Marine Resources Management Project for Korolevu-i-wai, which was implemented in 2001 by The Institute of Applied Sciences of the University of the South Pacific in collaboration with concerned government departments, highlights how the fisher community and the local government jointly regenerated fishery resources through coastal resources management. The Korolevu-i-wai experience attests to how a community can rise above the obstacles associated with *de facto* open access nature of fisheries. It offers hope to many coastal communities in a similar situation with an unwavering resolve to avert resource deterioration.

FISHING FOR THE FUTURE: CO-MANAGEMENT AND THE INTRODUCTION OF RIGHTS-BASED FISHERIES MANAGEMENT SYSTEMS

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Fisheries scientists, managers and policy makers agree, that the management of small-scale coastal fisheries needs to take place as close to the marine resources as possible, i.e., at the local level. The delegation of fisheries management functions and responsibilities to sub-national administrative levels, the sharing of these with fisheries stakeholders and the introduction of some form of user or property rights over fishery resources are widely seen as a prerequisite for making fishing a sustainable endeavor. Without efforts to introduce some form of user or fishing rights and restriction of access to local fisheries resources, any such co-management effort in coastal fisheries management is bound to fail – at least in terms of resource recovery and sustainability.

A brief overview of the present fisheries management approaches and systems in Southeast Asia shows that most of the countries in the region have initiated processes and pilot projects, which strive to establish such participatory fisheries management systems. Still, coastal and aquatic resources continue to decline at alarming rates. To counter these trends, SEAFDEC is striving to support innovative fisheries management processes and approaches through various initiatives, which are aimed at promoting rights-based fisheries management systems and strengthening locally based fisheries management.

However, the regional review of small-scale fisheries management approaches shows, that any effort to set-up and strengthen sustainable fisheries management systems at the local level is undermined by factors, which go far beyond those which are usually identified to be the cause of failure of such fisheries co-management experiments. It is argued, that unless fisheries managers and policy makers acknowledge and address these root causes for the elusiveness of successful locally-based fisheries management systems, both in terms of resource recovery as well as sustainability, any effort in adjusting the institutional framework of fisheries management through legislative reforms, increased stakeholder participation, improved Monitoring Control and Surveillance will fall short of the much desired objective of sustainability.

The paper concludes, that only a fundamental shift in the perception of and attitude towards fishing and the fisheries sector, can ensure sure, that there will be fish to eat for the generations to come.

MISSING THE FISH FOR THE TREES? FISHERIES CO-MANAGEMENT AND COMMUNITY FORESTRY IN SOUTHEAST ASIA – LESSONS TO BE LEARNED

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Forestry and fisheries have a number of important characteristics in common: they are common-pool resources, characterized by subtractability and difficulties to exclude users. They are also important natural resources for the livelihoods of poor communities. Unfortunately, in recent years they have been under pressure from various sources and sectors, leading to an increase in vulnerability and non sustainability. This has been due to intense and/or competing exploitation of the resource as such, changes in land cover, infringement on and reduction in critical habitats, and others. Another aspect in common is the difficulty to quantify and value traditional resource use.

A comparison between fisheries co-management and community forestry in Cambodia, Lao PDR, Thailand and Vietnam is presented and commonalities identified as well as differences, emphasizing lessons to be learned for fisheries co-management from community fisheries.

FISHERIES CO-MANAGEMENT IN LAO PDR – THE USER PERSPECTIVE

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Incorporating local perspectives is an essential component of co-management, enabling local systems to be recognized and legitimized. Commonly management functions requiring local input include data gathering, harvesting, fish marketing and utilization, etc.
The paper presents the user perspective in the fisheries co-management of four irrigation reservoirs in Lao PDR, and is based on a presentation prepared by user-managers for an international meeting in summer 2004.

Major issues raised are: 1) division of management tasks by gender; 2) management process at different levels contributing to co-management agreements (plans); 3) major benefits and problems as perceived by the user community.

Surprisingly, different from government-managers, who tend to think in fish, user-managers gave a clear vote to the importance of involvement in planning and more inclusive decision-making as major positive outcomes of the co-management experience.

ALTERNATIVE SOURCES OF INCOME: A WAY OUT IN FISHERIES MANAGEMENT?

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Conventional fisheries management is defined by the FAO as the 'integrated process [relating to] regulations or rules which govern fisheries in order to ensure the continued productivity of the resources and accomplishment of other fisheries objectives'. In short, it deals with fish, the fishery and the (physical) environment. More recently however, fisheries management has been understood to comprise a broader set of activities, including some which are not directly or exclusively related to fisheries as such, but take place in the wider society and economy of communities concerned. This view has been strengthened by a recognition of the complexity of rural livelihoods, which are characterized by multiple and interlinked activities.

One such area of 'new' fisheries management is the identification of alternative, or complementary, sources of income and the development of 'non-fishing income generating activities', or 'NFIGAs'. The main objective of this management intervention is said to reduce the increasing pressure on fish resources and thus to maintain fishing a viable economic undertaking. Therefore, and in particular in implementing fisheries co-management, which is meant to be 'people-centered' and responsive to local diversity and complexity, the development of sources of "alternative income" has been a widely used management tool.
The paper starts from the establishment of fisheries co-management in Cambodia, as a result of a fisheries management policy reform under implementation since 2000. More specifically, it analyzes fisheries co-management of four waterbodies (reservoirs and river sites) in the provinces of Kandal and Kampong Cham. Chief to co-management at these waterbodies has been the formulation and implementation of management plans by the 'co-managers', that is, local users organized in 'Community Fisheries' (CFs) and government staff from provincial and central offices of the agencies concerned. Management plans include fisheries–related activities as well as NFIGAs. Among the latter are small-scale fishing gear sales; handicraft production; the setting-up of rice and cow banks; and family fish pond culture.

Stated objectives for developing these sources of "alternative income" are 1) to create or increase income for individual households in rural communities; 2) to generate income for the CF organization; 3) for CF members to have in kind support for daily needs; 4) to provide an incentive to CF members, especially to CF committee members, to actively participate in CF management and development in a sustained way; 5) to reduce the pressure of fishing activities in natural water bodies by creating alternative employment in the local areas; and 6) in the long run, to contribute to poverty alleviation.

The paper shows that, although so far alternative livelihood activities have provided only small amounts of cash, there are good indications that their contribution to objectives 1 – 4 can be realized. However, keeping in mind the overwhelming importance of capture fisheries for Cambodian rural communities, it remains to be seen to what extent NFIGAs will indeed contribute to objectives 5 – 6, that is, to safeguard fisheries sustainability andalleviate poverty.

TRAGEDY OF THE RESOURCES OWNERSHIP IN MARINE PROTECTED AREA: CASE STUDY IN WEST-LOMBOK, INDONESIA

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The paper discusses the issues and complexities that arise when a marine protected area (MPA) is established in marine area which used to be perceived as communal property. The analysis is based on the analytical framework of the institutional performance of such MPA wherein the ownership issue takes place. Ownership issue is not free from conflicts that may involve local people and state, both the local government and the central government. The paper is based on case study in Gili Indah Village, West Lombok, West Nusatenggara Province, Indonesia.

Tragedy of the resource ownership occurred when the central government policy developed Gili Indah as a Marine Natural Tourism Park (MNTP) and a Water Natural Conservation Area (WNCA), which is identical with MPA. According to this decree, this MNTP can be utilized for various purposes: (a) tourism, (b) research and development, (c) education, and (d) culture supporting activities. This decree seems centralistic, top down, and undermining the traditional or customary right.

To implement MNTP and WNCA policy, the central government developed the Agency for the Natural Resources Conservation (KSDA) as a representative of the central government. With this policy, a protected area is then determined and considered as a newly created state property, even though this protected area overlaps with communal property boundary, so such state property right area is undermined by the local fishers. The establishment of Gili Indah as MNTP prohibited all activities considered to be destructive fishing practices. This includes muroami net, which is commonly operated by Gili Indah fishers. Accordingly, KSDA attempted to prohibit muroami- net operation within Gili Indah area. This KSDA's action is certainly synergetic to what the tourism entrepreneurs (TEs) group, which is a new economic class in Gili Indah, trying to enforce. As a result, the coalition between KSDA and TEs group lead to profound impact on the loss of fishers' common property right. This tragedy of resources ownership eventually caused the fishers' resistance to MNTP and WNCA.

CURRENT DECENTRALIZATION OF FISHERIES MANAGEMENT IN INDONESIA

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This article provides an analysis on current trend in decentralization of fisheries management in Indonesia. Decentralization policy in Indonesia has been proceeded by the establishment of Undang-Undang 22/1999 (the local autonomy law), where local government has got new authority over marine-fisheries management. However, theoretically decentralization becomes the most appropriate form of fisheries governance which enables local governments to control local fishing by community based management system□CBFM□. The CBFMs in Indonesia are found and rooted among traditional fishing communities. Nevertheless, the role of these systems has been undermined by the central government because of political decision that marine areas should be nationally owned. In the decentralization era, however, these traditional systems may be reconsidered as the main social and cultural capital of fisheries management, particularly for coastal fisheries. The article reveals that to implement decentralization of fisheries management requires key conditions for success, especially those related to legal framework, capacity building, and revitalization of local and traditional institutions. These key conditions will decide the success of co-management system where in the central government; local government, users, and civil society are involved and responsible for the implementation of sustainable fisheries management.

MONEY MATTERS: CREDIT AND SAVINGS AS IMPORTANT ELEMENTS OF FISHERIES MANAGEMENT

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While it is true that viable fisheries need viable fishing communities, to guarantee the latter is a multidimensional undertaking, requiring not only technical, but more so organizational, institutional, communicative and financial capacity-building.

Since 2000, fisheries co-management has been developed and implemented at reservoirs in the Central Highlands province of Daklak in Vietnam. There, reservoir management aims at high and sustained returns from fisheries, but also at family and community welfare. Thus, one of the most important management activities has been the setting up and continuous support to credit and savings groups at originally six locations, as an integral part of activities of the local management organizations, i.e. Fisher Unions.

The main reason for this activity has been that, while there is credit available from banks, procedures to obtain and repay it are too difficult and too inflexible for poor families. Furthermore, the time and money poor families invest in organizing to manage the fishery must achieve as much benefit for the community as possible, and the benefit from managing the fishery alone may not be enough.

Important objectives were: 1) to support fisheries management (substitution of gear used in unsustainable fishing methods; fisheries enhancement); 2) to provide funds for family emergencies; and 3) to develop sources of income other than fishing. The system of group credit and savings is based on mutual trust and mutual benefit; it is flexible, it provides money at conditions convenient to group members, i.e. low interest rates and adaptable repayment schedule; and loans are provided to families, not individuals.

Some groups have shown a great degree of readiness to manage credit and savings, have done so smoothly and effectively, and are continuing to do so. However, implementing the activity has not been without problems in all cases. In fact, some groups stopped after a time as one or more members refused to pay back loans, or due to other reasons that made them stop saving. Solutions for other issues, such as how group benefits are to be shared among members, or how individuals responsible for collecting and keeping funds should be compensated for their efforts, had to be devised.

It has been found that the bulk of funds created were used in the following activities: 1) substitution of electrofishing equipment, and stocking; 2) development of agriculture and livestock; 3) to support households in emergency situations, as well as support to poor community members who, though scoring high, have difficulties to continue schooling due to lack of funds. While credit and savings thus contributed to the objectives and expectation from that activity, added benefits were that 1) community groups participate in a management exercise, which better equips them for managing other issues, such as the fishery; 2) interest collected by credit groups could be used to support other activities in the community, 3) it brings people together, and furthers group cohesion; and 4) it has a high rate of loan recovery compared to other forms of financing.

A special consideration was given to the role of women in credit and savings. Culturally, women play an important role in (family) financial management. So, while most families are registered in the credit and savings groups under the name of the male household head, participation in credit and savings activities is mostly by women, which has benefited the viability of the groups due to a high degree of discipline and compliance with group rules.

MARKETING AS AN ESSENTIAL FUNCTION IN FISHERIES CO- MANAGEMENT: THE CASES OF HUAY LUANG (THAILAND) AND NAM HOUM (LAO PDR)

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Fisheries management is an inclusive undertaking. It is not limited to data collection and resulting design of input/output controls, or stock and habitat enhancement measures. But, in addition, it comprises actions aimed at regulation of supply flow, product quality and diversity, and the development of relevant institutional processes. In short, fisheries management comprises much of what is conventionally called 'fish marketing'.

To give fish marketing a prominent role in fisheries management, and, in particular, fisheries co-management, is justified by a number of factors, some of which are: 1) it is through markets, that most fishers realize the benefits of their efforts; subsequently, it can be assumed that market consideration influences largely how the fisheries is conducted; 2) fish marketing is an activity with strong participation by women and thus provides a major condition for the involvement of the entire community in management; 3) though fish-related, fish marketing is a source of "alternative incomes" through the development of value-added fish products; and 4) participation in fish marketing is one of the few possible sources of funding for activities undertaken by the fisheries co-management organizations.

Fish marketing (fish processing and fish trading) figures prominently in a number of fisheries management plans which have been developed and are being implemented by user communities in collaboration with local level government staff, under the support of the Mekong River Commission's Fisheries Programme.

In the Northeastern Thai reservoir of Huay Luang (Udon Thani Province), women of the local user community have formed 'fish processing groups' with a view to maintaining fish price even in seasons of glut landings, by processing surplus catch into fish sauce and other fish products. A prerequisite for conducting this activity in a successful way was an analysis of the socio-economic system and market demand of traditional fish products. Moreover, while the traditional product called *Pla Ra* is commonly marketed "passively" through visiting merchants, the new fish products (fish sauce and fish crispy) are being marketed "actively" by women groups developing and applying several strategies.

This is a good example of addressing women's practical a strategic concerns and priorities in fisheries development and management, and on how interlinked such concerns are. While fish processing is certainly a practical concern, i.e. improving presently activities, the fact that additional income may be earned, which can change the situation of a women and her family – and even the community in which she lives – makes it to be of immense strategic concern.

Fish marketing at Nam Houm reservoir in Lao PDR's Vientiane Municipality was said to be subcontracted by the local district authorities to a 'monopolist trader'. In fact, after closer scrutiny it now seems that the arrangement is not so much a marketing concession, but a fishing concession. Unfortunately, the subcontractor does not reinvest profits from the sale of 'his' fish into fisheries management, which is left to the local fisheries co-management organization. Calculations have shown that proceeds from fishing and fish marketing would be more than enough to guarantee a sustainable fishery. Efforts are now underway to make the user community participate in fish marketing at Nam Houm.

MEDIA - A POWERFUL TOOL TO CREATE AWARENESS IN THE COMMUNITY FOR FISHERIES RESOURCE DEVELOPMENT OR, AN AGENT IN CREATING MASS AWARENESS IN COMMUNITY BASED FISHERIES MANAGEMENT PROJECT

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FemCom Bangladesh is a professional women's media group established in 1992. It works to address poverty, social injustice, gender inequalities and sustainable development through various multi-media works.

FemCom Bangladesh is working for community based fisheries management project to create mass awareness among the fisher folk and community at large, from 1996 'till today. To execute this above mentioned project FemCom produced various multi-media materials under the project which include video productions, audio cassettes, still photographs, posters, booklet, monthly press report on fisheries issues and open stage folk theater program. In FemCom's outstanding perspective & attitude to create mass awareness through all these media materials, it is really notable that, open stage folk theater is a low cost, easily understandable or communicable and acceptable to the target audience. So far, under this project FemCom has trained up 14 folk theater groups. 70% of participants come from the fishing community who does not know how to read and write. Moreover, among these groups in each group there are 40% of women participants who are actively playing their role to disseminate the messages of community based fisheries management (CBFM) project. So far, from the information collected from all PNGOs and our further follow up program, we can say that, it has been appraised in all levels, that these folk talents are working as an effective tool or agent in achieving the ultimate goals of CBFM-2 project.

Findings of the programs:

These programs started in November 2002. In last one and a half year the followings were found:

- ➢ 6 PNGOs' 14 groups did total 700 shows and through each show the CBFM project's messages were disseminated to approx 2,100,000 people. Among them 900,000 was female.
- ➢ Previously, women never thought of performing in the open stage shows specially the grass-root level women. In this CBFM project's program 75 women are actively working which are bringing the following benefits for them.

  - Now they have gathered enough courage to come out of their houses and talk in front of the mass people.
  - They have got the chance to expose their hidden talent
  - Moreover the honorarium they get from CBFM project for doing these shows, that is creating a source of extra income.
  - Their socio-economic status is being gradually up-lifted.

- ➢ Apart from these, these talents are not only performing in the open stage shows in the village level, they are also getting the chance in the national media level like : Television,
- ➢ Cinema media.

Influence of media:

Not only open stage theater program under the CBFM project, there are so many other media output as well, which are drawing the attention from grass-root level to the policy making level about CBFM project concept. Because CBFM project is trying to incorporate the most popular national singer, actor, actress to disseminate the message through mass media. The press report, prepared under the media activities is also being used by the Department of Fisheries along with other PNGOs as their secondary material and source for any advocacy programme. Along side, still photography, publication is helping the project and respective PNGOs, WFC & DOF for their various documentations.

COASTAL AREA MANAGEMENT BY LOCAL ORGANIZATIONS: HOW PEOPLE PARTICIPATE IN THEIR COMMUNITY DEVELOPMENT, CASE STUDY APPROACH IN THAILAND

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Decentralization is gaining importantance in recent times in Thailand. The Thai government has established a Sub-district organization to decentralize authority and delegate responsibilities from central to local level, namely, The Sub-district Administrative Organization (Ao.Bo.To.- in Thai). Even though the decentralization process is still incomplete, Ao.Bo.To. is becoming the management body in coastal resource management at local level. The local people's participation is promoted to in the decision making process for community development and the self-management of local resources within their territory.

In the case of KhaoThong Sub-District, Krabi Province in Thailand, the Ao.Bo.To and local people may cooperate in terms of development for their community. The leaders of the village and Sub-district have the authority to monitor both land boundaries and sea boundaries, according to the annoucement of the proclaimed area of the Sub-district. They can enforce measures against any illegal activities following the appropriate laws. Therefore boundary self-management is set up to protect their coastal area and local resources. This study focuses on the mechanism that makes cooperation between the Ao.Bo.To and local people efficient in community development. The practical process used for creating integrated development plans by all occupation groups in their community is analysed. Furthermore, the main factors in promoting success in self-management are discussed and how they negotiate their self-rule implementation with adjacent Sub-districts. The people can participate in community development by discussion to arrive at a consensus for the management measures to be implemented. Lessons learned from this case study will delineate the mechanism that will effect the cooperation between the Ao.Bo.To and the local people in their community development and also in coastal resource management.

COMMUNICATION PLANNING FOR PARTICIPATORY MANAGEMENT OF FISHERIES CONFLICTS IN CAMBODIA AND INDIA

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Conflicts in the use of aquatic resources are on the rise especially in developing countries in Asia. The fishery is not only a source of livelihood for the capital-rich investors and fishers with small gears, but it has become a source of food for the meanest survival of landless families in countries that remain to be at battle against poverty. Fisheries conflicts even involve non-fishery sectors such as farming, tourism and other 'development' proponents. Communication planning for managing conflicts is perceived as a tool for resolving conflicts or for establishing consensus-building procedures. A generic communication-planning matrix was designed arising from consultations with key informants and stakeholders. Using participatory approaches applied in fisheries management, country-specific communication planning matrices evolved from the generic model during country workshops participated by primary stakeholders including fishermen, fishing group leaders, farmers and community leaders; together with potential conflict managers such as the military, government officers, academics and policy-makers. The process shows the importance of local participation in conflict identification and communication strategy building.

Table 1 Communication planning matrix for fisheries conflict resolution involving key stakeholders in Cambodia and India, July 2004.

Stakeholders (Who)	Objectives (What)	Methods / Channels (How)
1. Cambodia		
Government officials	1. Building accountability 2. Improving enforcement (institutional change)	1. Provincial level public dialog
Media	1. Improve public awareness of causes and effects of conflicts 2. Influence government accountability on conflicts 3. Encourage conflict resolution	1. Press releases in newspaper to reach the government and government officials 2. Radio announcements to reach local fishers
NGO and Fishers	1. Influence government policies 2. Train fishers on improving attitude towards conflicts and resolution (local institutional change)	1. Training materials 2. Technical advice
2. India		
Government	1. Improve enforcement of fishery laws that are sources or those that could resolve of conflicts (Institutional change)	1. Refer to media, mainly newspapers, to highlight fishers problems, existing laws and enforcement process
Government bureau officials	1. Submit proposals on fisheries conflict resolution mechanisms to government	1. Refer to media (newspaper, television) to highlight sources and areas of conflicts
NGOs	1. Influence government 2. Train and build awareness of fishers on regulations (local institutional change) 3. Advocate for change in state laws	1. Dialogues and forums with government officials organized by NGO. 2. Develop training materials.
Traditional & mechanized fishers, and Community leaders	1. Enforce use of legal gears and area restrictions to avoid / reduce conflicts	1. Dialogues between fishers, leaders, and social organizations in the presence of government officials & NGOs 2. Produce and disseminate printed information materials

COMMUNITY BASED ORGANIZATION: KEY FOR SUSTAINING CBFM APPROACH

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Community Based Fisheries Management (CBFM) is an innovative approach in Bangladesh dealing with fishers' community with the goal of sustainable livelihood improvement of fishers dependent on inland aquatic resources in collaboration with Department of Fisheries, WorldFish Center and Partner-Non-Government Organizations (PNGOs) accompanied with local government and development allies. Community Based Organization (CBO) is a local people's organization that is formed by the elected members from primary groups of fishers' community following democratic process. Caritas, an PNGO executing Hamil beel, an inland culture based waterbody of 16 hectare under CBFM project, which has been managed by the community since 1996 through formation of CBO namely Beel Management Committee (BMC). The committee has been represented by the central nominated body of fisher community and they will continue fisheries management activities after handing over the responsibility from project part. The beel has total eight groups, which is accompanied with 182 members directly. Of these two groups are women with 43 members. Eight members execute BMC, who are elected from eight primary groups. Among them three members are in Executive Body and the remaining five are General Members, where two female representatives are selected. The study has identified basic elements for sustainability of CBFM project through CBO establishment and its proper functioning, *viz.*, establishment of access rights to the resources, organizing community in the form of group, educational program, training, income generation, savings, setting up local institution, development of bye-laws, long-term sustainable plan, implementation and coordination. CBO of Hamil beel has advanced progressively towards sustainability in terms of organizing and managing the beel ecosystem. Nevertheless, lease /income tax of the beel, short tenure of resource ownership, conflicts among beneficiaries as well as other resource users, less cooperation and inadequate study / institutional knowledge are sometimes hindering the way of sustainability. Long-term ownership, close follow-up in the areas of conflicts mitigation, CBO capacity enhancement, availability of study/knowledge at users level and sound coordination among stakeholders would prompt the whole process of sustainability of CBFM approach at Hamil beel. The paper will elucidate the elements of CBO management, sustainability and future implication in this arena.

COMMUNITY MANAGED FISH SANCTUARIES: EXPERIENCE GAINED FROM CBFM-2 PROJECT IN BANGLADESH

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For various anthropogenic and natural causes fish yields and species diversity have been declining in inland open waters in Bangladesh. Recently completed studies of IUCN revealed that 54 inland fish species in Bangladesh are threatened at varying degrees. Participatory assessment and planning with user communities emphasized the protection of parent fish stock in dry season habitats and controlling fishing efforts in dry months for sustainability of open water fish production and maintaining biodiversity. This paper describes the methods, approaches and community's initiatives in establishing and managing small-scale fish sanctuaries under the DFID assisted Community-Based Fisheries Management Project – 2 (CBFM2) in different types of inland open habitats In Bangladesh.

To measure the impacts of sanctuaries, catches of local fishers were monitored regularly at 15 days intervals around the sanctuary sites round the year as well as sampling the abundance of fish fry around sanctuaries during early monsoon when fish spawning peaked. Monitoring findings revealed 12% increase in fish catch after establishment of fish sanctuary in six months while over 37% reduction in catch was recorded in water-bodies where sanctuary was not established. Higher abundance of fish species was recorded in sanctuary sites compared to non-sanctuary sites - 5 fish species have been revived in the water-body with sanctuary which were not found in last few years.

THE INFLUENCE OF SOCIAL ACTORS ON COMMUNITY DEVELOPMENT: THE CASE OF A FISHING COMMUNITY IN SOUTHEASTERN PHILIPPINES

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This is the report of a study to identify social actors involved in a fishery resource management program sponsored by the government, and to investigate the perceptions of these actors about their identity when confronted with prerequisites for change. The purpose of this study is to highlight the influences of social actors, and how their conceptions and interactions affect community development practices and their outcomes. Using methodological triangulation, the empirical fieldwork was carried out in five fishing villages located in southeastern Philippines. The study identified numerous social actors involved in community – driven development. This research argues that neither the development framework of state functionaries nor the bottom-up model of NGOs can provide enough explanation for understanding organization/development dilemmas, nor does it offer a better solution for the reality of development in fishing community.

LIVELIHOOD ANALYSIS OF THE SHRIMP PROCESSING WORKERS IN BANGLADESH

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Fisheries activities have opened new avenues for employment for the landless rural people particularly for the women in shrimp industry in Bangladesh. There are 17,000 shrimp farms (both fresh and marine shrimp) which occupy 150,000 ha and 124 shrimp processing plants in Bangladesh. The processing plants collect harvested shrimps through a series of market chains and many people are engaged in these chains and get benefited. The government estimates that more than 600,000 people are directly engaged in shrimp production and processing activities. The present study addresses only the shrimp processing workers of different post-harvest segments. Shrimp processing offers excellent employment opportunities through a series of backward and forward linkages. Accordingly, different classes of people are directly and indirectly involved in the shrimp processing industry. The major actors are the faria, small and large depot workers, ice plant workers, ice crushing workers, bamboo basket makers, plastic drum sellers, transport chain such as van/boat/truck workers, commission agency workers and the processing factory workers. In many of these activities, women have employment opportunities and are actively involved in different activities in the shrimp processing industry. This paper examines through PRA techniques as to how the shrimp processing industry changed the livelihood patterns of the rural poor specially the rural women workers in southwest region of Bangladesh. For conducting PRA on the workers of different post-harvest shrimp processing activities, Paikgacha and Shamnagar thanas of Khulna district were selected where the harvested shrimp are processed through different channels. A total of 10 PRA sessions were conducted during 6-12 January, 2004 in which a total of 81 workers participated. The widely practiced PRA tools such as timeline analysis, flow diagram, mobility mapping, matrix ranking and some unconventional techniques were also used for a better understanding of the working community

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Evidence showed that a series of changes have taken place in the livelihood patterns of rural people due to conversion of paddy fields into shrimp farms. The areas where the workers involved themselves in the new production regime are shrimp and shrimp fry collection, transportation, marketing and processing. While the rural women were not generally involved in economic activities related to rice farming, with the introduction of shrimp farming, most women got involved in shrimp fry collection, shrimp processing resulting in improvement of their livelihood.

The condition of the housing, sanitation, infrastructure, transportation and education were very poor during the 1960s. In 1970s, a small amount of land was devoted to shrimp production by diverting the saline water to the farms without the permission of the Water Development Board which did not result in significant changes in housing, infrastructure etc. When the shrimp farming became profitable, a large number of rice farmers have taken to shrimp farming, as a result of which significant changes in shrimp business have taken place during 1980s. Due to the economic profitability, their housing, sanitation, infrastructure, transportation and education system gradually improved. To increase the shrimp product quality, government decided not to behead the shrimp in depots, resulting in unemployment of a large work force. At that time, non-crop activities like poultry farming were started. Poultry farming is progressively increasing. Overall the shrimp farming/business is in risk but the housing, sanitation, transportation, infrastructure and education have greatly improved in the study area.

PARTICIPATORY MONITORING OF TRENDS IN YIELD – DATA COLLECTION AND SHARING OF WHAT FOR WHAT?

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Without doubt, the provision of information is a major function of any fisheries management. Yet much too often such information is merely collected and without sufficient clarification of its purpose. Communication of data collected for agreed upon purposes is an important prerequisite for continued utilization of information in fisheries management. Consequently, the MRC Fisheries Programme (MRC/FP) has made information generation, information communication, and facilitation of information uses its three main outputs.

Among 'scientific managers' in conventional, top-down systems, there is, in general, a reasonably common understanding of objectives of information generation, parameters to be researched and monitored, and methodologies used. This is not necessarily the case when scientific and user-managers meet in a co-management arrangement.

An ongoing project of MRC/FP and other international fisheries development organizations on data collection and sharing mechanisms for co-management initially aimed at recommending a generic, almost universally applicable management information system. It quickly became clear however, that there are different management information requirements at different levels. The crucial part in designing fisheries information systems therefore is the process of defining management objectives and resulting data needs. In other words, it is not so much the question of 'what' to investigate, but the 'why' and the 'how', which have to be discussed and negotiated. Yet, a recent survey carried out in the respective fisheries line agencies found that there is still insufficient information on inland fisheries in each of the four riparian countries, and what exists does not inform fisheries management as such, but rather macro-economic policies. Adaptive learning therefore is an approach promoted by MRC/FP to be adopted not only in individual communities, but throughout fisheries management institutions in the region as a whole.

The paper presents information on the experience with data collection and sharing in fisheries co-management in Cambodia, Lao PDR, Thailand and Vietnam, and examines in detail such questions as: 1) the 'struggle for methodologies, parameters and indicators'; 2) 'scientific orientation' of government staff as a problem for involvement in co-management; 3) the possibilities of 'expert' participation in monitoring and evaluation, and, in particular, the communication of management information across organization levels and geographical scales, as a distinct contribution, or 'service', to be provided by government managers in a co-management system.

ECONOMICS OF FISHERIES CO-MANAGEMENT: HOW MUCH DOES IT COST, AND HOW TO PAY FOR IT?

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Decentralization of resource management, such as fisheries co-management, is believed to lead to an increase in sustainability, equity and efficiency of its outcomes. In particular the latter has a special appeal for the state partner in this collaboration: Doing more at less cost is attractive for cash-strapped administrations anywhere in the world.

Fisheries co-management in the Lower Mekong Basin (LMB) has shown to be efficacious, achieving some of the intended benefits (increases in catch and rule compliance; improved communication between 'managers', etc.). Its efficiency however, is harder to ascertain. This is partly because management or transaction costs in most fisheries are underestimated or insufficiently accounted for. This is particularly so in 'participatory' management. There, costs are said to be front-loaded, that is, they occur before or at the beginning of the enterprise, while maintaining the system is claimed to be almost cost-free.

Experiences with fisheries co-management supported by the Mekong River Commission's Fisheries Programme (MRC/FP) in the Central Highlands province of Daklak in Vietnam and Vientiane Municipality in Lao PDR provide interesting examples: The fishery of Lak lake in Vietnam's Daklak Province is characterized by high biodiversity, but declining catches, mainly due to increasing fishing pressure (increase in fishing effort; use of destructive fishing methods). In 2001 the management organization changed from a bureaucratic Executive Board to a Fishers' Union, set up to better represent the interests of various sub-groups and to actively manage the lake. The Fisher Union compares favorably with the Executive Board, both in terms of efficacy (achievements of management objectives) as well as efficiency (degree of financial losses). Unlike in the Executive Board however, about 50% of the Union's costs are opportunity costs incurred by members for time spent in meetings. Thus, 'participatory management' is costly, both in money as well as in time. Similarly, at irrigation reservoirs in Vientiane Municipality in Lao PDR, a huge amount of time and effort has gone into management planning. But there may be little benefit in a good management plan if there are no funds to implement the activities. Unfortunately, decentralization of management has generally not meant decentralization of funds. So what devices have been found by user-managers to pay for management costs?

In Daklak, the Fisher Union has been given the right to levy taxes on its members. But success here depends on the extent to which the Union will be able to count on its members' cooperation. At the Lao PDR reservoirs, the local co-management organization now receives funding through Government to be spent within the framework of the management plans. The benefits are many: it will enable "deep decision-making", based on funds actually within reach of community managers; improved administrative capacity of the user organizations, and increased transparency, accountability and "ownership" in the real sense of the word.

The paper shows the following: 1) transaction costs are mainly borne by the user partner in the co-management system; they are high, and don't only occur at the beginning only; 2) despite this, these costs can be paid for by the user community, provided adequate institutional arrangements are in place; 3) such institutional arrangements have to cater to both sides, governments and user-members, and conditions favoring collective action, such as joint objectives, communication, transparency and ownership are essential ingredients.

COMMUNITY-BASED MONITORING OF A SEAHORSE FISHERY USING FISHER LOG BOOKS

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A small-scale fishery supplying seahorses (genus *Hippocampus*) for export, either dried for traditional medicines or live for aquarium display, was monitored in Northern Bohol, Central Philippines. Seahorses were collected by fishers as part of a multi-species fishery, which also included spear-fishing for fish, cuttlefish, squid and hand-collection of abalone, crabs, sea cucumbers and shells. Seahorses were caught at night by fishers using kerosene lamps attached to small non-motorized boats in order to locate and hand-capture seahorses (primarily *H. comes*). The monitoring program was established to; (1) gather information on the size and health of the seahorse fishery, (2) infer the status of seahorse populations and (3) suggest necessary actions/recommendations for management of the fishery.

Identified seahorse fishers were provided log-books, laid out as monthly calendars (called *catch calendars*), in which they recorded their daily fishing activity noting the number of seahorses caught, total hours spent fishing, timing and location of fishing and other species caught. As such, the accuracy of the data was dependent on fisher participation and recall. Originally established in one focal community in 1996, the project was expanded to 9 other seahorse fishing communities (*barangays*) in 2000. Sampling was conducted monthly prior to 2000, when it was reduced to the identified peak (March, April, May) and lean (August and October) seasons for logistical reasons. Calendars were distributed at the beginning of each month by researchers and regular site visits were conducted during the collection period to encourage participation.

Temporal and spatial trends in catch and catch per unit effort (CPUE) will be used to assess the health of the seahorse fishery and the populations on which it is based. The effects of confounding factors present in monitoring an open-access, multi-species fishery will also be discussed. This study also provides insight into the benefits and problems of involving local fishers in monitoring and its potential role in guiding small-scale fishery management.

COMMUNITY PERCEPTIONS OF MARINE PROTECTED AREAS IN NORTHERN BOHOL, CENTRAL PHILIPPINES: MANAGEMENT, BENEFITS AND THREATS

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Project Seahorse Foundation (PSF) has facilitated the establishment of 12 community-based Marine Protected Areas (MPAs) within the Danajon Bank region, Northern Bohol, Central Philippines. Community support and involvement are viewed as key factors in the success and persistence of these no-take marine sanctuaries. As part of an MPA program that includes regular biophysical monitoring, a new initiative to assess community perceptions of their relationship with local marine sanctuaries and the role of PSF was carried out. The perceptions survey was conducted by interviewing key informants (minimum of ten per barangay) using a standardized questionnaire devised by the Coastal Conservation and Education Foundation (CCEF). This organization is responsible for the establishment of a Philippines nation-wide MPA database and standardized ratings system to assess MPA effectiveness. Perception surveys were carried out by an experienced social researcher at ten communities with an associated MPA that was categorized as (1), old and PSF established; (2), new and PSF established; (3), old and not assisted by PSF and (4), PSF involvement phased out. An assessment of the impact of these MPAs through the perceived community ideas on awareness, support and understanding of the MPA will be presented. Results on the status of governance and marine resources with particular reference to fish catches, participation in decision making, achievements and failures in MPA operations are all shown to be useful indicators of MPA success and can be employed by the communities for further support of their MPAs and to direct effective management.

THE EFFECT OF CO-MANAGEMENT PROCESSES ON ENFORCEMENT AND COMPLIANCE WITH FISHERIES REGULATION

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Compliance behavior among fishers is influenced by the economic gains of the fisher and of personal and social characteristics. In view of the increasing use of co-management as the strategy for addressing urgent issues of marine resource depletion and poverty in artisanal fisheries, it is hypothesized that co-management may involve processes that would promote better enforcement and compliance. Co-management is a partnership in which responsibility and authority for fisheries management are shared between the government and the local fishing community, and ideally entails the greater active participation of the fishers in the planning and implementation of fisheries management.

This study tests the extended model of deterrence when the variable of level of co-management is incorporated. The effect of the independent variables (level of comanagement, involvement in decision-making, enforcement experience, management's capability to enforce, moral reasoning, probability of enforcement, social influence, fish catch, perceived legitimacy) on compliance is expected to be stronger in the sites with the longer experience with co-management. The model of compliance is summarized as: COMPLIANCE = f(deterrence, economic, social and psychological factors, level of co-management)

Three study sites in the Philippines were selected to represent three levels of com-management: 1 (high), 2 (low) and 3 (none). Three hundred twenty six respondents were interviewed on variables pertinent to compliance with fishing regulations. The Probit and Tobit regression analysis tested the compliance model.

The Probit regression on the pooled sample from the three areas shows that Level 1 is a significant predictor only for the basic deterrence model. Fishers who live in Level 1 with its greater experience in co-management tend to violate more. However when social variables are included through the extended model, the effect of being in a high co-managed area disappears. Although at a lower alpha significance (.10), Level 2 area is also a predictor of violation. The separate regression run on Level 1 respondents revealed that involvement in decision-making, probability of being accosted, perceived management capability to enforce and moral reasoning yielded significance. Involvement in decision – making is a significant predictor but not in the predicted direction; thus respondents who perceive greater involvement of fishers in decision-making are likely to violate. The variable "perceived management capability to enforce" is not a significant predictor. Both involve processes which are promoted by co-management.

The directions of results for the other independent variables are discussed. The counterintuitive effect of comanagement on compliance is speculated to be a reflection of the dynamic perceptions and experience with co-management. Implementors should take active cognizance of this dynamism and provide the necessary iterative and timely interventions.

IMPACT OF CBFM MICROFINANCE PROGRAM ON THE LIVELIHOODS OF FISHERS AND FISHERIES PRODUCTION IN BANGLADESH

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Community Based Fisheries Management Project in Bangladesh aims at testing and researching community management fisheries, restoring fish habitats, developing media on these issues and reviewing fisheries regulatory and policy frameworks. All these activities are being addressed following several models by the NGOs. In order to better manage the waterbodies, reduction of fishing pressure appears to be an important intervention. This demands activities like establishment of sanctuary, seasonal closure, area closure, banning of broods and juveniles and so on. Since poor fishers' livelihood is directly affected with these regulations at least temporarily, alternative income generation appears to be an essential component of the project to enable them to earn income during the period fishing remains closed. To implement this strategy, the CBFM-2 project provides micro credit for different income generating activities i) to support additional livelihood for poorer people, ii) to add value to wetland related income, iii) to generate alternate incomes during closed and lean season, iv) to develop savings habit among poorer communities, and v) to reduce pressure on wetland resources. All these are meant for improvement of fishers' livelihood and sustenance of fishers' community based organizations. The microfinance program of the CBFM has been providing funds to these ends for a couple of years. So far impact of this microfinance programme has not been investigated or assessed in any systematic way. The proposed study aims at addressing these issues using data from CBFM-2 project. The paper presents analysis of the impacts of micro credit on community based management especially fishers' livelihood improvement, flow of earning during slack period, sustenance of involved community based organizations and improvement in fisheries production.

MANAGEMENT OF FISH SANCTUARY: LEGAL ISSUES AND OPTIONS

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This abstract highlights the legal issues pertinent to the management of fish sanctuary as a conservation approach. The overall objective of the detailed study is to look into possible legal, institutional and policy frameworks to provide for the implementation of conservation methods like sanctuaries in inland fisheries with community participation.

The Government of Bangladesh has categorically stated in favour of conservation of resources that in many instances is yet to meet with corresponding laws and regulations. Fishery is such a sector where the conservation commitment of the government has not been adequately dealt with by the existing laws despite the fact that fishery is the largest source of protein supply for the people of Bangladesh and that the resource base is threatened with over exploitation. The Red Data Book of IUCN identifies 12 species of sweet-water fish as critically endangered while 28 endangered and 14 vulnerable conditions. These lists were also designed to generate attention to the disappearing species and conservation needs to protect them.

This paper scrutinized the conservation aspirations of the government with regard to inland fishery as recorded in various laws and policies, the limitations of such commitments, and the possibility and mode of incorporating new conservation principle for managing certain water bodies or their part as fish sanctuaries. To suggest pragmatic measures as to how and what changes need to be brought in the existing legal regime, the researcher has also examined laws of other countries with similar provisions.

FISHERIES MANAGEMENT AND LEGAL ASPECT OF CBFM

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The goal of the Community Based Fisheries Management (CBFM) is to promote participatory management of inland fishery that will further improve the livelihood of the poor people dependent on inland aquatic resources. This would be achieved by developing; conserving, testing and assessing arrangements for community based fisheries management across the diversity of inland fisheries and by informing and facilitating appropriate changes in policy and thus contribute to the poverty alleviation.

The regulatory regime governing fisheries are either substantial or procedural in nature. The substantive laws deal with conservation and/or protection of private, public, inland and marine fisheries while the procedural laws set the administrative guidelines and mechanism followed in the management of fisheries.

All these laws regulate the fishing in private/public fishery, fishing method, time, species and appliances and control fishing rights in certain fishery by requiring the possession of a valid lease or ownership. The environmental management of fisheries as regulated by the provisions of these laws provides for declaration of conservation zone and prohibits polluting activities. The laws, however, are not detailed on conservation measures like establishment and operation of sanctuaries that are largely practiced by NGOs under various projects like CBFM. These aspects of conservation are yet policy commitments.

This paper shall highlight on the regulatory and administrative regime on fishery. It shall examine the legal aspects of ownership and management of fisheries; access of communities to fisheries, present management system; laws; laws of environment conservation and pollution vis a vis the traditional rights; management of fishery vis a vis the other production sectors, present institutional arrangements; role of communities in fisheries management, present mode of community based fisheries management, various aspects of such CBFM module (institutional, sustainability, traditional rights, conservation practices etc.) and so on. Apart from the laws, administrative guidelines and subsequent circulars as issued by the Ministry of Land (MoL) to regulate the management of state owned fisheries shall also be emphasized.

The major regulatory, administrative and bureaucratic obstacles for implementation of projects like CBFM shall be noted with critical review of the regulatory regime and presentation of case studies undertaken in the process of CBFM implementation.

The objective of the paper will be to assess the relevance of CBFM practices in the context of existing fishery management systems. The paper shall recommend on the possible regulatory measures needed for the sustainability of community based management systems. The areas where the age-old laws on fisheries need to be amended shall be identified with recommendations that will attempt to reflect the positive policy commitments.

The recommendation shall emphasis on harmonizing and bringing in coherence between policy and legal commitments. The institutional aspects of community based fisheries needs more policy and legal emphasis as opposed to *ad hoc* arrangements and hence the recommendations shall identify a practical mechanism and desired code of conduct.

ANALYSIS OF KEY LIVELIHOOD CONSTRAINTS OF PRIMARY STAKEHOLDER GROUPS BY USING SL APPROACH AS A TOOL: EXPERIENCES OF CBFM-2 PROJECT IN BANGLADESH

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Sustainable livelihood approach (SLA) is presently being considered as an effective tool for achieving poverty reduction in developing countries like Bangladesh. Sustainable livelihood framework analysis is an important part of the approach which helps achieving better understanding of rural livelioods. In the recent years, SLA is promoted and adopted by the DFID for their development projects in Bangladesh. Government of Bangladesh has been developing poverty reduction strategy paper (PRSP) of the country targeting eleminating poverty by 2015 which is being focused and identified different livelihood issues as the area of future development work. The second phase of Community Based Fisheries Management project (CBFM-2) is being implemented in Bangladesh with the financial support of DFID. Center for Natural Resource Studies (CNRS) as an pro-environmental NGO is working under the umbrella of CBFM-2 in association with the WorldFish Center for implementing the project in different types of water bodies located in a variety of ecosystems of the country has given emphasis for analysing the rural livehoods.

Participatory Action Plan Development workshop has been conducted in all project sites to develop a consensual plan of action involving multi stakeholders for implementing project activities. As a part of PAPD, problem census sessions were conducted with different stakeholder groups to generate a list of key livelihood constraints by the stakeholder groups. This paper presents results of problem census conducted in 5 sites of CBFM-2 which are being categorized and analyzed by using sustainable livelihood frame work- as a tool.

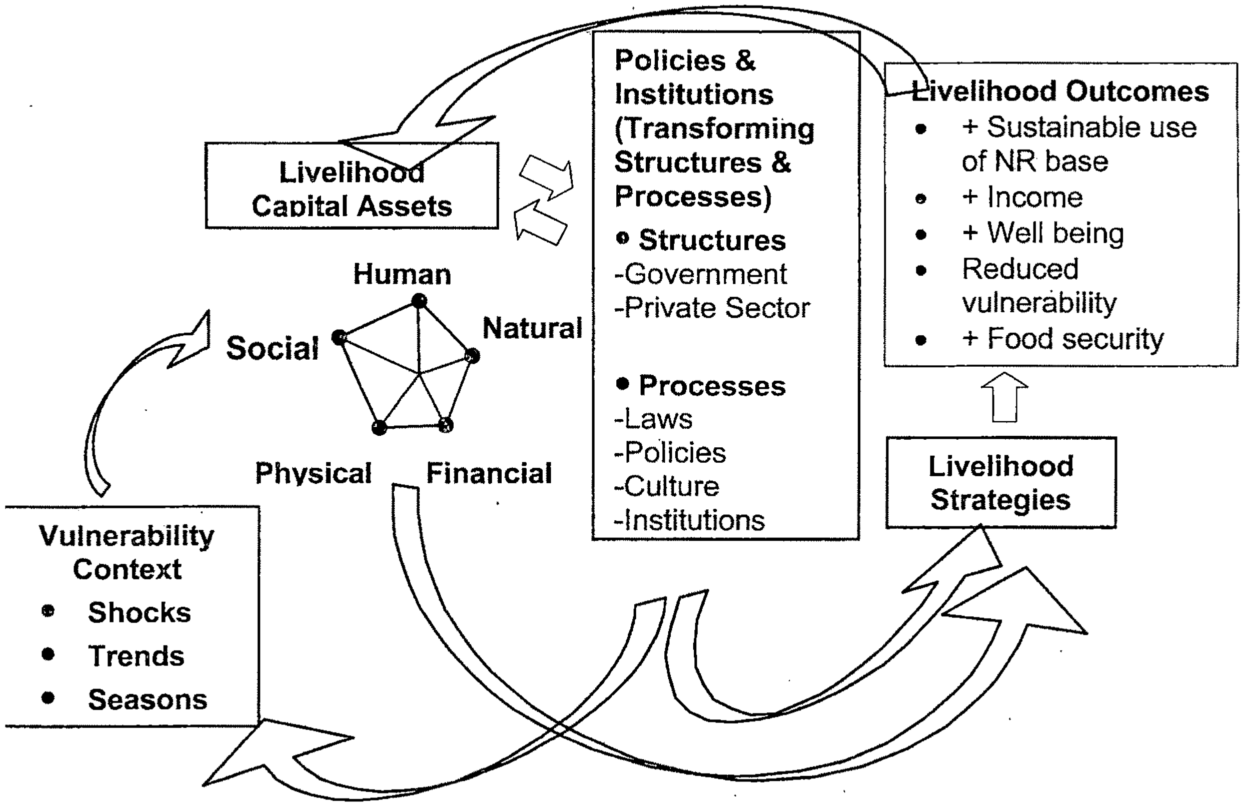

Fig: Sustainable Livelihood Framework (DFID Model)

PAPD (PARTICIPATORY ACTION PLAN DEVELOPMENT) - A PARTICIPATORY TOOL FOR CONSENSUS BUILDING AMONG STAKEHOLDERS OF MULTI FUNCTIONAL WETLANDS: EXPERIENCES OF CBFM-2 PROJECT IN BANGLADESH

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Wetlands system in Bangladesh is a complex in both physical and social context. In multifunctional wetlands, different primary and secondary interest groups or stakeholders represent many divergent aims, desires, requirements, acts and positions in relation to the resources the wetland offer. Traditionally the perspectives and interests of local influentials are the ones that come to dominate, resulting unsustainable and unequitable management systems of wetlands. This paper, on the basis of experiences gathered from Community Based Fisheries Management project, Phase-2 is being implemented by CNRS in association with WorldFish Center- Bangladesh and Department of Fisheries (DOF), presents in detail a process, based on a series of stakeholder workshops, that aims to build mutual understanding and learning of the issues facing diverse stakeholders in wetland management, thereby creating a platform for consensual management.

The process has its roots in a number of approaches to addressing multi-actor situations, and particularly draws on methods for understanding complex problems involving people and their divergent perspectives (Soft Systems Methodology: Checkland & Scholes, 1990); participatory planning and community envisioning (Future Search: Weisbord & Janoff, 1995); and appraisal of communication flows in rural communities (RAAKS: Saloman & Engel, 1997).

The tool has been developed and tested in Bangladesh floodplain wetlands through action research in development projects including CBFM-1. The methodology involves a series of separate and multiple stakeholder meetings to achieve the optimum balance between giving a voice to the traditionally voiceless and yet achieving inclusive outcomes ratified in an open forum. The key steps of the process are:

- Familiarisation with bio-physical and socio-economic character of a particular wetland system through PLUS (Participatory Land Use Survey) exercise
- stakeholder analysis of primary and secondary stakeholders for managing the wetland
- 'Problem Census' to identify separate stakeholder groups' key livelihood constraints and identification of possible solutions/interventions
- a plenary workshop with all stakeholders to cluster resource management problems of common concern, prioritization of problem cluster and identify the best potential solutions
- workshops with separate stakeholder groups to appraise these solutions from their group perspective (in a forum not dominated by traditional power-brokers)
- a final plenary workshop with all stakeholders to share the outputs from individual sessions and build a shared framework of understanding as the platform for agreeing an action plan for wetland management and a local organisation to implement it
- conflict management and micro level intervention planning
- implementation of the resource management action plan developed in the PAPD.

CO-MANAGEMENT APPROACH IN PROJECT IMPLEMENTATION: EXPERIENCES OF CNRS (AN NGO) IN IMPLEMENTING FOUR SELECTED CO-MANAGEMENT PROJECTS IN BANGLADESH

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The approach of co-management of NRs by the government, local communities/CBOs, NGOs/ civil societies and donors is increasingly expanding throughout the world. The co-management approach in Bangladesh is still in its juvenile stage, which aims for socially just and ecologically sustainable management of NRs, mostly fisheries resources. A number of co-management projects have been implementing in the country focusing NRs of both fresh water and coastal environment. Center for Natural Resource Studies (CNRS), a National NGO has been working with a number of co-management projects which are being targeted on NRs protection, management, conservation and sustainable use in different ecosystems in Bangladesh. All the projects which are being implemented by CNRS have been focused on wetland resources management and conservation under co-management arrangement.

MACH (Management of Aquatic Resources through Community Husbandry) is a USAID supported project where different government agencies, local government bodies, CBOs, groups, international non-profit organizations (Winrock Internationa and Eco-system science, based in USA) and three national NGOs (CNRS, CARITAS and BCAS) are involved from 1998 has been managing fresh water resources. SEMP (Sustainable Environment Management Program- component 2.2.1/A) is a UNDP supported national level project where a ministry of government, an international NGO (IUCN), a national NGO (CNRS), CBOs and groups are involved in the project implementation from last six and half years has been managing haor resources (deep fresh water basin). ECFC (Empowerment of Coastal Fisher community) is a FAO supported project where Department of Fisheries along with a TA team, number of NGOs including CNRS and fisher communities are involved in managing coastal resources of Cox's Bazar and Teknaf peninsula in Bangladesh. CBFM-2 (Community Based Fisheries Management project, phase-2) is a DFID supported project where Department of Fisheries, number of NGOs including some specialist NGOs, communities, CBOs, groups and worldFish Center are involved in managing frsh water capture fisheries resources in Bangladesh. CNRS is also involved in this project.

This paper summarizes CNRS experiences of four different co-management projects which are being implemented in a diversity of ecosystems in Bangladesh and evaluates the perceived and actual impact of co-management by projects and ecosystems. It also explored and suggested key conditions for successful co-management projects to be implemented in near future in Bangladesh focusing wetland resources.

POLLUTION ISSUES AND ITS TREATMENTS IN CBFM-2 PROJECT

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This abstract highlights the pollution issues and its treatments in CBFM-2 project as a part of protecting open water resources in Bangladesh from hazardous affects. In this respect, the case of Nandinar Beel (Water Body of CBFM-2 project) has been analyzed. Adjacent to Nandinar Beel in Badarganj Upazilla, Rangpur District in North-West Bangladesh there is a chemical factory that was polluting the Beel and adjacent fields. The factory management had taken no preventive measures to stop effluents entering the beel. As a result, fishes were decreasing and paddy fields were affected, fishers' requested the factory management to stop and taking mitigation measures but they could do nothing to prevent these. BRAC under CBFM-2 project helped the fishers' community to organize together. The main objective of the study is to look into possible legal issues and how the success has been made with the support of fishers' community and CBFM-2 partners. However, the Government of Bangladesh has categorically stated many laws, plans and policies directly or indirectly in mitigating pollutions at a minimum stage. But most of the laws are not in actions effectively. Bangladesh Government has established the Department of Environment (DoE), but still they are not competent enough to prevent all pollutions of the whole country. Apart from this, pollution of air, water and soil are punishable offences according to the Environmental Conservation Act, 1995 and there under issued the Environment Conservation Rules, 1997. But most of the polluters with their strong power relations and influences they are showing negative attitudes to the respective authorities violating the provisions of laws. It is worth mentioning here that under the laws of the country, each of the factories must have to set up "Waste Treatment Plant" to mitigate of the chemical wastes but presently it is not available in most cases. Repeated discharge of untreated chemical effluents had being caused immense harms to the flora and fauna, and affected fish productions. Considering all of the factors and circumstances, community members, other stakeholders and BRAC decided to raise the issue to the other partners of the project, accordingly, BRAC requested the Department of Fisheries, BELA and FemCom. Furthermore, rectangular actions were taken by the above mentioned agencies in the said disputed area in the name of "Alternative Disputes Resolution". Agencies talked to the alleged Managing Director of the polluter factory and discussed overall situations and issues. Subsequently, a request letter was sent to the Managing Director of the factory to stop water pollutions, immediately. It was also informed him that otherwise, legal actions will be taken. Lastly, the Managing Director was bound to establish a dam in between of the factory and waterbody. Now a days, Nandinar Beel is one of the resourceful waterbody and also profitable for the fishers' community of CBFM-2 project. This paper scrutinized the pollution related issues, policies, plans and conventions of the country. To suggest pragmatic measures as how and what actions need to be taken to fight with the giant polluters and how to go forward with support of other service providers and agencies.

COMMUNITY FISHERIES MANAGEMENT IN CAMBODIA—CHALLENGES AND OPTIONS FOR SUSTAINABLE MANAGEMENT

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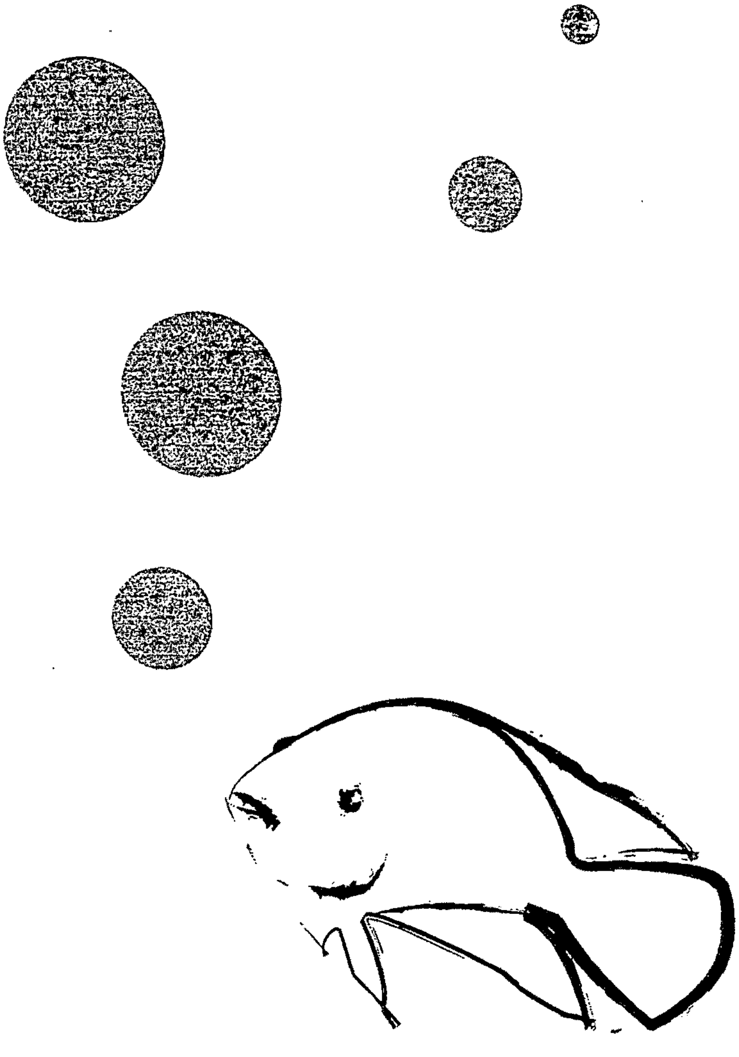
In view of the natural resources management challenges facing Cambodia, FAO has been working with the government to provide guidance and direction for effective and participatory management of the community fisheries. Community based fisheries management was initiated in Siem Reap province in the year 2000 with help of FAO and since then 13 organizations have been established and are playing a big role of harnessing community energies for sustainable development and management of the fisheries resources.

In 2003 we initiated a monitoring program to evaluate the effect of Community Fisheries Management in the 13 Community Fisheries organizations in Siem Reap Province. The uniqueness of the Program was that the implementation was done by the fisherfolks themselves who recorded fish catch characteristics, the fishing methods used by fishers during the period monitored and any other illegal activities. The fishers' exercise provided information on the prevailing fisheries management issues with recommendations to improve the management of the resources.

The results from M&E were also suggestive of a trend towards over-exploitation of the Tonle Sap Lake fisheries on which the community fisheries depend. Successful management of Tonle Sap lake fishery will therefore require collective action for all resource users and this is the basis for the fledgling Community Fisheries initiative in Cambodia.

SS Inland Fisheries



CAMBODIAN FRESHWATER FISHERIES: AN OVERVIEW

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With a yield of 290 000 to 430 000 tons a year and a population of 12 million, Cambodia is home of the most intensive freshwater fishery in the world in terms of catch per inhabitant. With more than 350 species recorded, 100 fishing gears and 20% of the country that classifies as wetlands, fish biodiversity, fishing techniques and floodplains are also exceptional.

This paper provides an overview of Cambodian fisheries, including ecological features, exploitation patterns, environmental figures and social aspects. This summary is based on a review of published as well as unpublished grey literature. Cambodian fisheries features are then put in the broader context of the Mekong basin aquatic environment and aquatic resources.

Table 1 Annual freshwater fish catch population and catch per inhabitant of the top four countries

Country	Fish catch 2000 (FAO stats; tons)	Population 2000 (CIA World Fact Book)	Catch/inhabitant (kg/capita/year)
China	1,222,955	1,265,830,000	0.97
India	416,490	1,014,003,817	0.41
Bangladesh	591,300	129,194,224	4.58
Cambodia	245,300	12,212,306	20.09

CATCH MONITORING FOR FISHERIES ASSESSMENT IN THE SONGKHRAM RIVER, UPPER NORTHEAST THAILAND

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In northeast Thailand the Songkhram River is the last remaining large Mekong tributary which is not dammed in its lowland reaches, so it is particularly significant as an indicator of baseline conditions of rivers in this region. Each year the river experiences a large natural flood, which inundates large areas of floodplain, leading to high production of fish and other aquatic animals. Another factor in high production is unimpeded migration of fish and other aquatic animals between the river and floodplain, and between the Songkhram and the Mekong River. The fishery involves thousands of people, including subsistence, artisanal and full-time fishers, as documented in an earlier baseline survey.

Plans for "development" of the basin include more dams for flood control and irrigation, and each year there are more fishers and increasing fishing pressure, so monitoring is needed to provide information for management. Trends in the fishery could be indicated by monitoring catches, consumption or markets. This study reports on preliminary results of catch monitoring of fishers, carried out as a trial over a one-year period to assess methods and the usefulness of results.

We used a participatory approach where fishers were trained to fill catch logbooks. Twelve fishers were employed from four sites in the lower part and middle part of the basin. The fishers used six methods: bag net, beach seine, standing trap, gill net, hook-and-line and tom trap in three main types of habitat: river/stream channel, flooded area and permanent water bodies.

Standing traps were widely used by fishers and have many advantages for long-term monitoring of catches in river channels. However, gill nets were the most effective gears used for catch monitoring in a range of habitats in the dry season.

Using local fishers is much cheaper and more effective than conventional sampling by a fisheries agency. The fishers are experts, they own and maintain all required gear at low cost, and by working with them agency staff develop good relationships which can form the basis for co-management. However our study showed the need for care in designing data forms and in training fishers in data recording, and also highlighted some ongoing issues with taxonomy and classification of Mekong system fishes.

MARKETING INFRASTRUCTURE, DISTRIBUTION CHANNELS AND TRADE PATTERN OF INLAND FISHERIES RESOURCES IN CAMBODIA: AN EXPLORATORY STUDY

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The paper provides an exploratory analysis of marketing infrastructure and distribution channels of fish and fish products in Cambodia. This is a comprehensive study that takes into account stakeholders involved in the supply chain. The study selected three provinces around Tonle Sap Lake and the Phnom Penh city to cover key fishing grounds, retail markets and landing sites from where most of the fish are channeled to the key cities and export points. To assess household level fish marketing, the study selected three villages from each of the three selected provinces and interviewed 45 households in each village. Important landing sites around the Phnom Penh city and in the selected provinces; three retail markets (one urban and two rural) of fish and processed fish were observed and monitored in the selected provinces. The study selected 10 markets (2 big, 3 medium and 5 small) following proportionate random sampling procedure. The study also interviewed fish exporters in Phnom Penh city, Kendal, Kompung Chnang, Siem Reap, Kratie and Stung Treng provinces. To understand the fish marketing system and its importance to the lives of the small-scale fishing communities, the study observed and monitored landing sites and retail markets in the selected provinces. There exists significant gap between prices at the fishing ground and retail and export markets due to multiple intermediaries in the supply chain, and to a significant extent due to legal and illegal toll collections on road. Small-scale fishing households mostly catch low value fish that are not tradable to the neighboring countries. The study reveals a grave picture of fish handling and processing at all levels of the distribution chain. The country may earn more benefit from its fish export if they are able to add value through quality and synchronize the dispersed supply chain.

RESERVOIR FISHERIES OF SRI LANKA: PRESENT STATUS AND FUTURE STRATEGIES FOR MANAGEMENT

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The inland capture fishery in Sri Lanka is almost entirely based on the multitude of perennial reservoirs in the country. The fishery is a relatively recent development after introduction of the exotic cichlid species, *Oreochromis mossambicus* into Sri Lankan freshwaters in 1952. *O. niloticus* introduced in 1975 is also well-established in reservoirs of the island. These two cichlid species, which form over 90% of total landings in the perennial reservoirs of Sri Lanka, are sources of affordable sources of animal protein for rural communities. In addition to this unique characteristic of dependence of the fishery on two major species, there are two important features as regards to the resource-based management of the fishery i.e., the use of non-mechanized fibreglass canoes, approximately 6 m in length manned by two persons; and the gear used comprising exclusively of gillnets (6-20 net pieces per craft), ranging in mesh size from 7.5 cm to 12.7 cm, with each net piece being of a standard length and height of 60 m and 1.5 m, respectively.

Small sized cyprinids are also abundant in Sri Lankan reservoirs, which can be differentially exploited using small-mesh (15-52 mm stretched mesh size) gillnets without catching juvenile *O. mossambicus* and *O. niloticus*, which are only found in shallow (<1.5 m), littoral areas of reservoirs. Their adult counterparts, which are targeted by the fisheries, are found in deeper water and are not vulnerable to small-mesh gillnets. These small cyprinid species (i.e., *Amblypharyngodon melettinus*, *Puntius chola*, *P. dorsalis* and *P. filamentosus*) are used to make fish meal or died fish because of their high nutritive quality.

Various resource-oriented approaches such as length-based fish stock assessment methodologies and empirical yield predictive models have been employed to determine the optimal fishing strategies in the perennial reservoirs of Sri Lanka. However, these approaches are inadequate for effective management of fisheries in perennial reservoirs of Sri Lanka, as they do not take into account the social component which makes use of the resource. It is therefore imperative that fishing communities be made active partners in decision-making processes. A co-management procedure in which the centralized fisheries administration authority and fishing communities share the responsibilities of making decisions for fishery resource management should be introduced for effective management of the reservoir fishery of Sri Lanka.

SPATIAL AND TEMPORAL VARIATIONS IN FISH ASSEMBLAGES OF AN ARID ZONE FLOODPLAIN RIVER, COOPER CREEK, AUSTRALIA: IMPLICATIONS FOR ENVIRONMENTAL FLOWS

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In many large floodplain rivers fish assemblage structure varies significantly among isolated waterbodies remaining on the floodplain after flood recession, even when such waterbodies are situated in close proximity. This paper documents similar spatial variations in fish assemblage structure within isolated waterholes along four reaches of the Cooper Creek system, Australia, during the 2001 dry season, and at one reach (Windorah) over 2001-2003. Spatial variations in waterhole fish assemblages were in part a function of the structure/availability of habitat within a spatially nested physical hierarchy - the floodplain, the whole waterhole and patches of habitat within waterholes. At each level of this hierarchy, the type/availability of habitat was strongly influenced by the antecedent and prevailing water regime, particularly the extent of floodplain inundation 14 months before the dry season of 2001, and water depth/volume over the 2001 dry season. Waterhole fish assemblages were increasingly differentiated and species abundances typically decreased markedly (overall by 93%) with the passage of the dry season. Loss of habitat structure/availability influenced these processes. Annual summer flow pulses that replenished waterholes at Windorah were associated with recovery of fish populations and species richness. We suggest that hydrological variability must be maintained if we wish to sustain the distinctive habitats and fish assemblages of Cooper Creek and other arid-zone river systems. The implications of these findings will be discussed in relation to the management of water resources in arid regions, and the provision of environmental flows to sustain aquatic ecosystems.

SOCIOECONOMICS AND VALUES OF AQUATIC RESOURCES IN CAMBODIA: RESULTS FROM A SAMPLE SURVEY OF GREAT LAKE TONLE SAP AND MEKONG BASSAC RIVERS

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The paper seeks to determine the value of the resources of the Great Lake Tonle Sap and Mekong-Bassac Rivers using both market and non-market approaches of valuation. The principle objective of this paper is to provide an estimate of economic values of the aquatic resources and its importance to the livelihoods of fishers, farmers, traders and exporters; and to measure the dependence of the households on the resources of the Great Lake Tonle Sap and Mekong-Bassac Rivers. The paper is based on survey of 410 households in nine villages in three provinces in the Lake and Mekong-Bassac area. Results suggest that most of the sample households are small-scale fishers, use traditional gears such as gill net, bamboo made traps and fences, folded woven traps, harpoon and hook long lines and host of other fishing techniques. On the average, two members of each household are engaged in fishing of which female to male ratio is 0.33. Each of the households spends on the average 19 hours per week. Average close season weekly catch per household was 12.6 kg and almost 73% of the weekly catch was sold. Average selling price of fresh fish is USD 0.39. The households caught as many as 107 species of which top twenty species constitute 79% of the total catch volume during the week before the interview and only 8% of the total catch belong to top 20 species in terms of value that ranges between USD 0.54 to 1.25 with the average price of USD 0.69.There is a significant positive relationship between gear value and total average catch, consumption and sale. The average catch is 13.215 tons for the households who owns more than USD 300 worth of gear. The lowest value (less than USD 15) gear owners have the lowest production in both open and close season, which are 36 kg and 22 kg, respectively. In the close season, an average household consumes 7.91 kg of fish that includes fresh fish (5.57 kg), fish ball (1.38 kg) and fish egg (0.96 kg) per week. The average consumption of meat products (chicken, beef and pork) is much lower than that of fish, which is 2.54 kg. The percentage share of fish to total animal protein is almost 76% excluding fish sauce and fish eggs. Nevertheless, households in the lake area derive enormous direct and indirect benefits from the lake resources. Households collect firewood, different kinds of vegetables, fruits, aquatic/wild animals and derive indirect benefits of water transportation, animal/duck grazing. Almost hundred percent of the households collect firewood, 84% morning glory, 65% water lily, 70% trouyrang, 63% phkasnor, 41% wild fruits, and 20 to 40% collect other fruits and vegetables. Different kinds of aquatic and wild animals are collected by 10 to 40% of the households. Almost 42% of the households derive indirect benefits of water transportation, and 10% animal grazing. On the average, taking all the resources together except fish and related activities, an average household gets USD 6.00 worth of values from the Lake and Mekong-Bassac River area. The estimated total value of the non-fisheries resources to the all households living in the area is around USD1.18 million.

LESSONS LEARNT FROM A ONE YEAR TRIAL OF OPENING THE SLUICE GATES ON A DAM OF THE MUN RIVER (A TRIBUTARY OF THE MEKONG) IN THAILAND –THE FISHERIES VIEWPOINT

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After the construction of the Pak Mun Dam in the Mun River (6 km upstream from the Mun confluence to the Mekong River), environmental changes became a controversial issue, especially in fishes and fisheries. Thus, in 2001, the Thai Government allowed the opening of all sluice gates for 1 year (July 2001 – June 2002), to explore the mitigation plans.

After the trial, there were 184 fish species from 44 families found. Some species, such as the freshwater giant stingray *Himantura polylepis* and mad barb *Leptobarbus hoeveni*, were recognized as species extirpated from the Mun River after the completion of the dam and could not use the fish ladder as the pass-way to move upstream. The catch-per-unit-effort (CPUE) and the percentage index of relative importance (%IRI) of the species varied temporally and spatially, using the dam as a barrier, between the downstream- and upstream areas. CPUE peaked in the downstream area in February 2001 and June 2002. In the upstream area, CPUE gradually increased from September 2001 to February 2002. There were drops in CPUE from February to April and then CPUE tended to increase thereafter. Amongst the species, black shark minnow *Morulius chrysophekadion* and the pangasiids largely contributed in the catches and after opening the sluice gates, %IRI-values of the rheophilic species increased.

The movement patterns from the Mekong into the Mun River of some adults of the important groups such as pangasiids, silurids and bagriids were observed. They trended to commence their upstream migration from the beginning of rainy season. While, the age-0 fishes were found in the late rainy season until the late winter.

During the study period, income from fishing activities significantly increased since the catch rate was higher than the rate during the closed period, especially many high market demand fishes. Moreover, some folk gears can be re-operated, especially the trap-fisheries in the rapid areas. After the study, the mitigation plan to open the sluice gates annually in the rainy season was proposed to the Thai Government, which seems to be the compromised way between the power supply and fisheries.

FISH MIGRATIONS IN THE MUN RIVER, A MEKONG TRIBUTARY IN THAILAND, WITH SPECIAL REFERENCE TO *Morulius chrysophekadion* AND *Helicophagus waandersi*

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During the one year trial, July 2001 to June 2002, of opening all the sluice gates of the run-of-the-river "Pak Mun" Reservoir (6 km upstream from the Mun confluence to the Mekong River) in Thailand, the potamodromous behaviour of some key-stone species was observed.

The catches were dominated by black shark minnow *Morulius chrysophekadion* and pangasiids. In the pangasiid group, shark catfish *Helicophagus waandersi* composed about 65 percent of the pangasiid catches. The presence and temporal changes in abundance of adults and sub-adults along the Mun River from the confluence to the Mekong mainstream toward the main floodplain area (about 50 km upstream) were used as keys to investigate the evidence of the migration of both species. The results showed that there was some degree of the migration, which mostly commenced at the onset of the rainy season. Therefore, the reproductive biology, of these two species, was consequently studied to verify the hypothesis on the reproductive migration.

During the rainy season, it was found that the ovaries of the adults of both species, which caught at the confluence area, were either in the maturation or maturity stages. Meanwhile some samples caught in the upstream area, their ovaries were in the spent condition. The larvae and age-0 fish of both species were observed in the late rainy season. This evidence supports that the purpose of migration is linked to the spawning behaviour.

BENTHIC FAUNA IN THE MUN RIVER AND ITS TRIBUTARIES DURING THE OPENING OF THE SLUICE GATES OF THE PAKMUN DAM

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The Mun River is the longest river in Northeast of Thailand and the largest tributary of the Mekong River in Thailand. The Pakmun dam was built in 1990 in Kongchium district, Ubonratchathani province, 6 kilometers far from the Mekong River. It has drawn attention from the public for the long period due to the conflict between the villagers and the government. In the year 2000, the villagers requested that all sluice gates be opened for 1 year and the ecological changes studied.

The taxa richness and abundance of benthic fauna were studied in the Mun river and seven of its tributaries by using Ekman Grab (15*15 cm.) from August 2001-June 2002 during the period of opening all sluice gates of the Pakmun Dam. There were 25 sampling stations spread from below the dam to above the dam. Sampling was carried out once a month. Four phylum of benthic fauna were found including Arthropoda (75.38%), Annelida (14.27%), Mollusca (10.25%) and Nematoda (0.13%), consisting of 47 families and 87 genus.The most dominant family was Chironomidae (66.5%), followed by Family Amblemidae (bivalve) and Family Tubificidae (earthworm). The average population number of benthic fauna was 23 individuals/m^2. The most abundant benthic fauna were found in May (62 individuals/m^2), April (44 individuals/m^2), January (29 individuals/m^2), December (27 individuals/m^2) and March (20 individuals/m^2). The least abundant period was in October (9 individuals/m^2). The average Diversity Index of benthic fauna was 1.15 which implies that the water quality of the Mun river and its tributaries was in a fair condition.

The average number of benthic fauna from this study (23 individual/ m^2) was less than the result of the other researchers (51 individual/ m^2) between 1999-2000 when all the sluice gates were closed. Twenty years ago, the abundance of benthic fauna in the Mun river was much higher (120 individual/ m^2). This indicates that natural food in the Mun River has decreased.

MAADEVALAYAL – UNIQUE FISHING METHOD IN VALAPATANAM RIVER

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Maadevalayal is an ancient fishing method practiced by the members of only one Muslim family in the Valapatanam river of Kerala, India. Fishing season is from February to May, every year when the river becomes shallow, and actual fishing is only for about 14 days in a month. Net is rectangular in shape, having two pieces, each about 250 m in length and 3 m breadth, made of nylon with 30 to 35 mm mesh size. 14 –18 fishermen operate the net using 4 canoes. During night the two pieces of net is dragged from about 1000 m distance and is fixed in a circular shape, foot rope inside the bottom and the head rope well above the water, using cassurina poles fixed about 5 m intervals. Hauling is carried out next day morning during low tide time. Poles are removed and pushing the foot rope from one side reduces the area inside the circle and finally the catch is collected in the landing part made by joining the foot rope at the other side. Maximum yield recorded is about 1000 kg/haul. Catfish, sand whiting and silver biddies constitute the major share of the catch. The paper deals with the design and operational details of the gear as well as the socioeconomic condition of the fishermen.

ESTIMATING CONSUMPTION OF FISH AND OTHER AQUATIC ANIMALS IN THE MEKONG BASIN: A COMPARISON OF INTERVIEW AND MEASUREMENT METHODS

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The Lower Mekong Basin in parts of Cambodia, Laos, Thailand and Viet Nam supports one of the world's largest and most important river-floodplain fisheries. Quantitative information on key features of the fishery, such as catches, consumption and marketing, is needed urgently to demonstrate the importance of the fishery to policy makers whose decisions influence its sustainability.

Interviews provide cheap and timely data for management, but results have often been reported and used as if they are free of bias. For example, the yield of the fishery has been extrapolated at around 3 million t/yr from various studies in which household members were asked to estimate their annual consumption of fish and other aquatic animals. None of the studies referred to possible bias in consumption figures, so the accuracy of the final yield figure is unknown.

This study aimed to develop methods for measuring consumption and to study possible bias in the results of interviews about consumption. Eight households were studied in each LMB country for one year (mid-2003 to mid-2004). The study was very intensive and intrusive so could not be carried out on a large-scale. The study included tests of weight estimation ability, quarterly interviews of household heads, and four 2-week periods of intensive food monitoring.

Preliminary data analyses indicate that: (i) people can accurately estimate weights of aquatic foods, within +-10% on average, (ii) people appear to consistently over-estimate consumption of fish and OAAs during interviews, when their answers are checked against actual monitoring data, (iii) the range of foodstuffs eaten is far more diverse than has been reported in prior studies, and (iv) interviews of the same people in different seasons give different results for species and amounts eaten.

Monitoring of any aspect of fisheries is time-consuming and expensive, and methods require adjustment for each target group to make them culturally acceptable and bias-free or subject to known bias. But the value of any work based on interviews would be greatly increased by follow-up monitoring of a limited sub-sample of interviewees to estimate bias in the data. The results could then be used to calibrate the interview studies. Our work can be used to provide guidance for development of combined interview/monitor studies to be applied in studies of consumption or other features of fisheries.

STATUS OF KATHA (FISH AGGREGATING DEVICE) FISHERY IN THE RIVER TITAS OF BRAHMANBARIA, BANGLADESH

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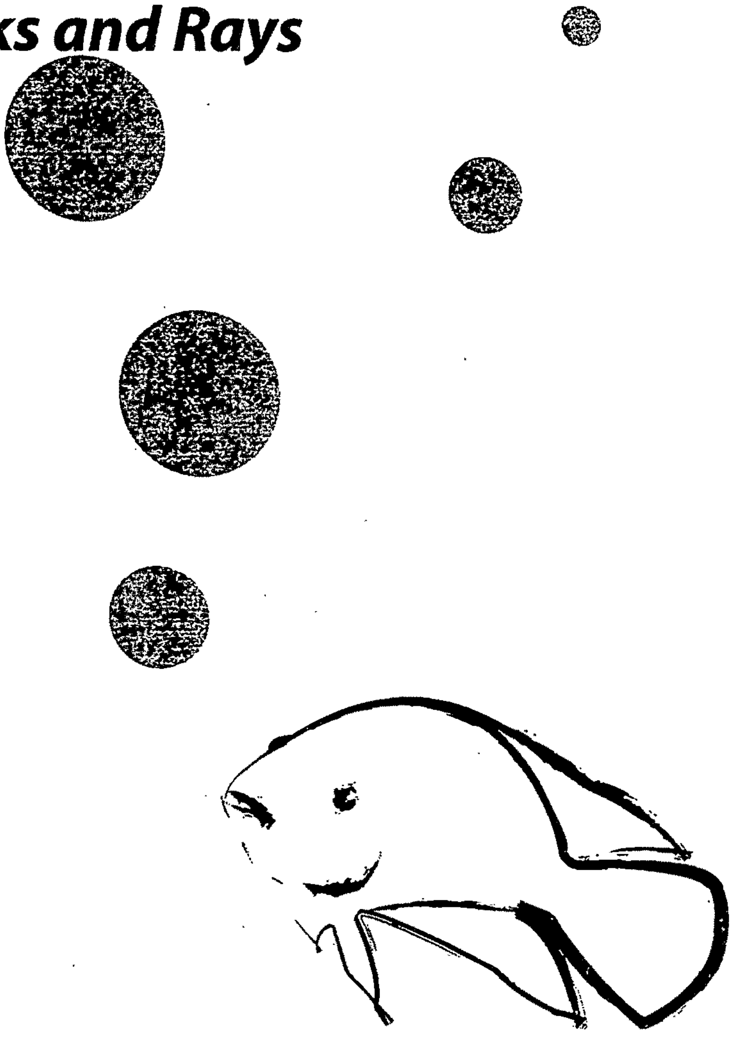
This contribution provide an overview of Katha (Fish aggregating device) fisheries in the river Titas and covers the fisheries characteristics and trends, and management issues relevant to the Katha fishing. This aggregating device mainly operated during Nov-May each year and size range varies between 0.8 and 1.3 hectare. Katha fisheries in this river accounted for 28.46%, 20.38%, 34.13%, 34.44%, 36.72% and 24.72% of the annual production in 1997, 1998, 1999, 2000, 2001 and 2002 respectively. *Mystus tengra, Walago attu, Channa marulis* and *Lebeo rohita* were the major contributor species in Katha fishery and accounted for 13.72%, 11.46%, 10.05% and 8.02% respectively. Annual fisheries production (kg/ha) were 304, 474, 558, 675, 763 and 762 kg during 1997-2002 respectively. Lowest and highest net benefit/katha were BDT 9855 and 21629 observed in 1998 and 1999. Competition and conflict among river fishery and Katha fishing are intense. About 97% of the Katha belong to farmer and fishers deprived from fishing. Brood fishes in the river trapped by the Katha, which create recruitment over fishing in the river. Statuses of a typical Katha fishery are discussed briefly.

SS Managing Fishing Impacts on Sharks and Rays



THE CHALLENGES FACING MANAGEMENT AND CONSERVATION OF CHONDRICTHYANS IN ASIA

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Worldwide, there is increasing concern over the exploitation of chondricthyans (sharks, rays, sawfish, and chimera). They are receiving a great deal of attention from both conservation and fisheries agencies such as the IUCN and FAO because of international concern over their population status. Fisheries for sharks and rays are difficult to sustain, as the population biology of these long-lived, slow-to-mature species, which have low fecundity, makes them particularly susceptible to overfishing.

Many shark and ray species have been increasingly targeted in south and Southeast Asia because of the very high value of shark fins. They are now the major target group for many artisanal fishers in Southeast Asia, particularly throughout Indonesia and the South China Sea. Recently, the Food and Agriculture Organisation (FAO) of the United Nations has developed an International Plan of Action for sharks. This plan requests that each country with fisheries for chondricthyans develops a National Plan of Action (NPOA) for sharks and where necessary, takes management measures to protect threatened species or stocks. Such NPOA's have already been developed in a number of countries, including Australia and Indonesia. Unfortunately, management and conservation planning for chondricthyans in south and Southeast Asia are hampered by lack of knowledge, both of the fish themselves and of the fisheries for them. Time series catch data are not available for most shark and ray fisheries and hence trends are hard to determine. Undoubtedly overall catch levels are increasing rapidly, particularly in Indonesia where >100,000 tonnes p.a are now landed. Importantly, sharks and rays are caught not only by target fisheries, both artisanal and industrial, but as an increasingly valuable bycatch in many fisheries, e.g. in tuna longlining and coastal gill-netting.

It is hoped that this symposium will contribute to our understanding of shark and ray fisheries in the region by highlighting what research is being undertaken and what more is needed. Also it is hoped that it will promote greater collaboration between scientists from different countries and agencies. There is a great paucity of data on most species in Asia, a point emphasized by the discovery in the last three years of at least 30 new species by a joint Australian-Indonesian research project. The shark and ray fauna of the outer shelves and slopes is particularly poorly known, e.g. in the Arafura – Timor Seas (extending in an arc from approximately 123° – 135° W Longitude and 4° to 12° S Latitude). The relatively poor understanding of the taxonomy and distribution of chondrithyans, as well as of their biology, hampers any realistic assessment of the flow-on effects of the fishing down of such top-order predators from the marine ecosystem. The development of effective NPOAs is hampered by this lack of knowledge, which can only be realistically overcome by collaborative efforts across the entire region to collate what information is available and to decide what aspects of research and data collection are most urgently needed to implement sustainable management measures to ensure the survival of shark and ray populations.

THE RECORDS OF ELASMOBRANCH SPECIES FROM MALAYSIA

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This paper is the outcome of a five-year (1999 – 2003) comprehensive study of elasmobranchs from estuaries, coastal areas, the Exclusive Economic Zones and also the freshwater bodies of Malaysia. The Marine Fisheries Resources Development and Management Department, Southeast Asian Fisheries Development Center, (MFRDMD/SEAFDEC) in Terengganu, Malaysia carried out the study in collaboration with Seikai National Fisheries Research Institute, Ishigaki Tropical Station, Okinawa Japan.

A total of 109 species of elasmobranchs belonging to 17 families of sharks (56 species), 12 families of batoids (51 species), and one family of chimaera (2 species) were recorded. Tentatively 29 species (15 species of sharks, 13 batoids and 1 chimaeras) were found to be new country records for Malaysia. The study also indicates that only 7 species of sharks and 5 species of batoids are common and widely distributed in Malaysia. Out of this, almost all the sharks and rays species are food fish (with exception of batoids from family Narcinidae).

A few species were very rarely found and restricted to certain areas and most probably are endangered and threatened. These species require serious protective measures to prevent them from becoming severely threatened or extinct. These species are Borneo river shark; *Glyphis sp.,* Largetooth sawfish; *Pristis microdon,* Longcomb sawfish; *Pristis zijsron,* Freshwater whipray; *Himantura chaophraya,* and Pale whipray; *Himantura signifer.*

A PROGRESS REPORT ON COLLABORATIVE RESEARCH INTO THE SUSTAINABILITY OF AUSTRALIA'S NORTHERN SHARKS AND RAYS

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The project *Northern Australian sharks and rays: the sustainability of target and bycatch species, phase 2* started in July 2002 and will finish July 2005. It is a collaboration between West Australia (WA), Northern Territory (NT), Queensland (Qld) and Victorian fisheries departments with CSIRO Marine Research as the Lead Agency. Fishery observers in WA, NT and Qld have completed field work collecting information on catch composition and other biological data. The Molecular Fisheries Laboratory at the Queensland Department of Primary Industries Deception Bay has commenced the population genetics study of two blacktip sharks species. The project and its phase 1 pre-cursor were identified by the Shark Assessment Group and National Plan Of Action-Sharks, as a high priority for national research in order to produce an updated risk assessment for Australian chondrichthyans.

Data collection is almost complete as the project enters its final year. To date, catch data from over 850 shots from gillnetting, long lining, and fish trawling have been collected. Catch data includes biological data from over 11,200 sharks and rays. A summary of biological data and the major issues arising to date, including the capture of critically endangered sharks (*Glyphis* spp) and sawfish (F. Pristidae) as well as a shift towards longlining for large sharks, will be presented. The risk assessment output from this project will contribute significantly to future nominations for protected species status of these and other Elasmobranchs in Australia as well to the management of shark fisheries in northern Australia.

STUDIES ON THE DOGFISH SHARK FISHERY IN THE NORTHWESTERN COASTAL REGION OF SRI LANKA

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Dogfish sharks (Family Squalidae) are taken in large quantities worldwide for human consumption and other purposes, such as fishmeal production and extraction of liver oil. In Sri Lanka, the fishery for dogfish sharks is highly seasonal and is carried out three to four months of the year..Preliminary investigations were conducted on the dogfish shark fishery in Thalawilla and Baththalangunduwa Island of Kalpitiya Peninsula from January 2004 to April 2004. Dogfish sharks in this region are mainly harvested by using baited hooks and the average number of hooks per boat ranges from 550 to 900 in both the landing sites. The fishing crafts used are fiberglass reinforced plastic boats with outboard motors. The average fishing time is about 10 hours and the fishing is carried out across a broad depth range (20 - 2000 m).

The main species caught are *Centrophorus uyato* and Centrophorus *granulosus*, which make up 86.8% and 13.2% of the catch respectively. The reported maximum total length of *C. uyato* was 83 cm while it was 94.5 cm in *C. granulosus*.

During the period of survey the highest catch was recorded in March 2004 (339,316 kg) in Baththalangunduwa, while it was in January 2004 (27,132.5 kg) in Thalawilla. The fishing effort varied considerably during the study period. There was a decreasing trend of fishing effort from January to April in Thalawilla, while in Bathalangunduwa maximum and minimum fishing efforts were reported in March and February respectively. The estimated figure for total dogfish shark production in Kalpitiya Peninsula during the present study was 448,523 kg. Of these, 57,294 kg was from Thalawilla area and 391,229 kg from Baththalangunduwa Island. Although the total dogfish shark production in Baththalangunduwa was higher than that of Thalawilla, monthly mean production in these areas were not significantly different from each other ($t= 1.03$, $n=4$, $p> 0.05$).

SOME ASPECTS OF SHARK AND RAY ARTISANAL FISHERIES IN SOUTH OF INDONESIA

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Preliminary studies on artisanal fisheries of sharks and rays in Indonesia were carried out during 2002-2004. A market sampling method was employed to collect fisheries data from a number of major landing sites, namely: Muara Angke and Muara Baru in Jakrta, Palabuhanratu and Cilacap in the south coast of Java, and Kedonganan in the south coast of Bali.

Large proportions of the shark and ray landings were by-product of tuna fishing by longline and tuna gillnet. The dominant landings of sharks were those belong to the families Carcharinidae, Squalidae, Alopiidae and Sphyrnidae, while those of rays were Dasyatidae, Rhinobatidae and Mobulidae. Most of the landings were processed into dried and salted product for local consumption

SIZE COMPOSITION AND FISHERY STATUS OF SOME COMMON SHARKS IN INDONESIAN WATERS

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Indonesia currently has the highest annual production of sharks and ray fisheries in the world. However, there has been no management or catch regulation to date. Indonesia lacks critical information about the shark and ray fisheries and also the biology of the exploited species. This situation makes the shark and ray resources very vulnerable to overfishing, particularly giving the biology of these species. A study conducted at shark fishery landing places in Sumatra, Java, Bali, and Nusa Tenggara from 2001 until 2004; found that generally sharks were caught at an immature size. Some common species such as *Carcharhinus brevipinna, Carcarhinus falciformis, Carcharhinus sorrah* and *Sphyrna lewini,* were caught at a size less than their maturity length in several landing sites in Indonesia. This has implications for the sustainability of these fisheries.

ELASMOBRANCH RESOURCES OF SABAH, MALAYSIA

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This paper presents 1) an overview of the landing statistics of elasmobranch fisheries in Sabah for the 1991-2001 period, and 2) the results of more than five years of collaborative study on the biodiversity of elasmobranchs in Borneo. Whilst landings of elasmobranchs for that period averaged at only 3.5% of the total annual fish landings, this does not truly reflect the socio-economic importance of this group. Taxonomic problems are also highlighted, with emphasis on the results and taxonomic implications of a review of the genus *Himantura*, the largest group of stingrays in the Indo-Pacific region. Current research and monitoring as part of conservation measures in elasmobranch management is provided.

ARTISANAL ELASMOBRANCH FISHERIES IN SOUTH-EASTERN INDONESIA: THE TARGET LONGLINE FISHERY FOR SHARKS IN LOMBOK

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Comprehensive surveys of the catches landed at five fish landing sites in south-eastern Indonesia were conducted on ten occasions between April 2001 and April 2004 to collect detailed catch composition data of the artisanal elasmobranch fisheries and types of gear used. A further six landing sites were also surveyed on at least one occasion during the study. A total of 131 species of elasmobranchs representing 28 families were recorded with as many as 20 of those species being potentially undescribed. Detailed information on the fishing gear utilised by fisherman at each site was collected throughout the study. Fisheries that target elasmobranchs in eastern Indonesia include tangle/gill netting for dasyatid and rhynchobatid rays, longlining for carcharhinid sharks and deepwater longlining for squaloid sharks.

The target longline fishery for sharks is most evident at the landing site of Tanjung Luar in Lombok and to a lesser extent at the landing site of Palabuhanratú in West Java. In Tanjung Luar, this artisanal fishery is a particularly large operation with up to 3 boats landing each day during the peak fishing season, i.e. March to October. Those boats operating pelagic longlines typically fish further eastwards towards Sumbawa and Sumba, depending on the time of year and weather conditions, whilst those boats operating demersal longlines typically fish closer to Lombok. A total of 25 shark species from 7 families and 1 rhynchobatid ray were recorded from this fishery at Tanjung Luar. The most abundant shark species observed in this fishery at this site were *Carcharhinus falciformis, Sphyrna lewini, Carcharhinus amblyrhynchos* and *Carcharhinus sorrah.* Size at maturity data for males of a number of species caught in this fishery was obtained during this study. The sharks landed by this target fishery are processed on site, immediately prior to the auctioning of the catches.

SOCIO-ECONOMIC ASPECTS OF SHARK AND RAY FISHING IN INDONESIA

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Catches of sharks and rays (elasmobranchs) are considered to be an important source of income to artisanal fishers in Eastern Indonesia. There is, however, growing concern about the sustainability of shark and ray fishing in Indonesia and a desire to develop management strategies to help ensure the continued viability of the fisheries. A key issue that needs to be addressed is the impact any controls on the taking of shark and ray may have on the well-being of artisanal fishers and their families. The objective of this study is to provide a preliminary assessment of the impact of any limitation on the taking of shark and rays on fishers and their families by conducting a case study of the artisanal fishery at Cilacap, Indonesia. Such information will prove important for the evaluation of potential future management policies directed towards the conservation of shark and ray stocks.

TOWARD A REGIONAL POLICY FOR THE MANAGEMENT OF SHARK FISHERIES IN SOUTHEAST ASIA

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Shark fishing is a difficult issue to address since sharks, rays and other elasmobranchs are mostly non-targeted catches in many fisheries. This is particularly true in Southeast Asia, where the situation is made even more intricate by the small-scale, multi-gear/multi-species nature of fisheries. The growing importance of the trade in sharks and shark products and the increasing profits has raised concerns about the sustainability of shark fisheries, compelling the ASEAN-SEAFDEC Member Countries into taking proper action. Consequently, the ASEAN nations have given recognition to the need to manage sharks and rays as a foreguard of fisheries in general, although most of these countries are severely constrained by lack of information on shark resources and associated fisheries.

SEAFDEC as a regional fisheries management organization has attempted to provide a forum for the Member Countries to discuss and build a common stand on the issue of shark fisheries management, as well as to support some related ad-hoc studies to form a basis for more sustainable data collection and fisheries management. Through a series of regional meetings, the Member Countries have progressively adopted a set of common positions, highlighted as follow:

- The management of commercial fisheries should come under purview of FAO not CITES. Any listing proposal to CITES, undermining sustainable exploitation and management of aquatic resources in the Member Countries should not be supported by the Member Countries. National fisheries agencies should be increasingly involved in the preparatory work for CITES with national competent authority, as well as participating to the national delegation to CoP-CITES.
- National Plans of action on Sharks (NPOA-Sharks) will be established in line with the International Plan of Action for the Conservation and Management of Sharks (IPOA-Sharks) supported by best scientific evidence under the framework of comprehensive sectoral fisheries management. Each Member Country will have a draft NPOA available by January 2005.

Last year, eight Member Countries started a one-year study on shark fisheries with the assistance of SEAFDEC. The purpose of the study is to explore mechanisms for future data collection and develop a basic understanding on regional shark fisheries to support their management and the development of NPOA-Sharks. Activities focuses on the fisheries, not on the resources, and include the identification of the main fishing gear capturing sharks, the composition of shark catches, the local utilization and trade of sharks together with their socio-economic importance at the landing site level, and some basic biological parameters. Complete results of the study are expected to be published by the end of this year. SEAFDEC has also initiated other activities on the identification of shark species by observation of dermal denticles and an in-depth study on shark trade in Singapore, Malaysia and Thailand.

NATIONAL PLAN OF ACTION FOR SHARKS IN INDONESIA

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Despite increasing awareness and concern regarding the depletion of shark populations and the sustainability of their fisheries there are few effective international management mechanisms in place and progress is seriously restricted by lack of data and resources. In 1999, the International Plan of Action for the Conservation and Management of Sharks (IPOA-Sharks) was ratified by FAO's Committee of Fisheries. Although voluntary, all shark fishing States are encouraged to implement the IPOA-Sharks by developing National Plans of Action (NPOAs) to improve species-specific catch and landings data, monitoring and management of shark fisheries. However, most countries have made little or no progress to date, and the few available national and regional plans vary widely in quality.

Southeast Asia has the most diverse elasmobranch fauna in the world and Indonesian waters have more than 300 species. Elasmobranchs are caught by both target fisheries and as bycatch in Indonesia with the highest reported annual landings of elasmobranchs worldwide (>100,000t), and exports of shark products worth over US $13 million. Given the rapid escalation and magnitude of Indonesia's catch and almost no information on the status of elasmobranch populations in the country, there is an urgent need to assess and manage the situation. Through collaboration with the CSIRO/Murdoch University ACIAR project and the regional SEAFDEC initiative, Indonesia has the opportunity to take a global lead in developing its NPOA-Sharks. This presentation outlines this proposal, suggesting priorities and actions to be undertaken at both a national and regional level to ensure effective implementation.

SHARK CATCHES IN MALAYSIA

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Sharks are currently facing heavy fishing pressure in Southeast Asia, even in Malaysia where there is no fishery specifically targeting them. The harvest of sharks is considered one of the unregulated fisheries in this region. Trade in sharks products is also increasing. Without the effective implementation of management measures for sharks, this important economic resource will be extinct which will be detrimental to the marine biodiversity.

This paper presents information on the capture of sharks in Malaysia based on a one year regional project (July 2003 – July 2004) between SEAFDEC and the Department of Fisheries Malaysia. The objective of this study was to get a better understanding on the landings, biology, utilization and marketing of sharks.

The major fishing gear landing sharks in Malaysia is the fish trawls. Other gears are gill nets, longlines and purse seines. The percentage of sharks in the total landings of fish trawls over the study period and sampling sites ranged from 0.3-5.7%. The higher percentage were mainly in Sabah and Sarawak

Some species are widely distributed such as *Chiloscyllium punctatum* (Grey carpet shark), *Carcharhinus sorrah* (Spot tail shark), *Sphyrna lewini* (Scalloped hammerhead), *Rhizoprionodon acutus* (Milk shark) and *Carcharhinus leucas* (Bull shark). Maturity stages of sharks caught ranged from juvenile to mature.

Almost all parts of sharks caught are consumed. Sharks are marketed as fresh meat, frozen meat, dried salted meat, sharks bone, sharks skin and sharks teeth. These products are mainly for the domestic market and a small amount exported to a few countries such as Singapore and Hong Kong.

The results of this study provided scientific information for the formulation of the National Plan of Action for Sharks (NPOA-Sharks) in Malaysia. This plan will be the management tool to ensure the conservation and sustainability of this group of fish.

ASSESSING THE SUSTAINABILITY OF ELASMOBRANCHS IN INDONESIAN ARTISANAL FISHERIES USING RISK ASSESSMENT TECHNIQUES

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Worldwide, there is increasing concern over the exploitation of elasmobranchs. This is because most elasmobranchs are long lived, slow to mature and have low fecundity making them vulnerable to over fishing. Indonesia has the richest chondricthyan fauna in the world and also has the highest annual landings of elasmobranchs worldwide (>100,000 t). Although data on the landing and effort are sparse, there is a strong indication that catch per unit effort (CPUE) is decreasing. In addition, there are no reliable species-specific catch data available from Indonesian elasmobranch fisheries and little management of elasmobranch resources. There is also an almost complete lack of data on the biology of Indonesian elasmobranchs with many species unknown to science.

Collaborative research between CSIRO Marine Research, Murdoch University and RCCF Indonesia has been collecting baseline data on the elasmobranch catch, fishing methods and areas fished from selected markets throughout Indonesia, and are currently obtaining more detailed biological information on species that are shared between Indonesia and Australia. Information on areas fished and species distribution is also being collected and will be used to assess the status of shared stocks and conduct a risk assessment on elasmobranch in Indonesia.

This presentation focuses on the risk assessment of elasmobranchs at six markets in Indonesia where sharks are landed. The sustainability of sharks captured by the fishery was determined using their susceptibility to capture and mortality in the fishery (susceptibility) and their capacity to recover once depleted (productivity). Species were ranked on each characteristic and the ranking reflects their ability to resist fishing pressure and therefore, their priority for management, monitoring and research. Data on the risk assessment methodology and output are presented. Due to the diversity of fishing gear used in Indonesia combined with the high retention of catch, a large proportion of elasmobranchs were classified as high risk. These include tuna bycatch species such as *Alopias pelagicus*, *Carcharhinus falciformis* as well as target species such as *Himantura fai*, *H. gerrardi* and *Rhynchobatus spp.*

RECENT RECORDS OF *Glyphis* AND *Lamiopsis* FROM NORTHERN AUSTRALIA AND SOUTH-EAST ASIA

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The carcharhinids *Glyphis* and *Lamiopsis* are placed in separate genera by Compagno (1984), but are very closely related. As originally noted by Garrick, there may be a case for combining these mostly rare and enigmatic sharks into a single genus. *Glyphis* comprises 4-6 species of tropical Indo-West Pacific riverine and coastal sharks, while *Lamiopsis* is represented by a single inshore coastal species. CSIRO Marine Research has been involved in a number of recent chondrichthyan surveys in northern Australia, as well as in the Philippines, Borneo and Indonesia. During these surveys one specimen of *Lamiopsis* was recorded from Java and several specimens from near Kuching in Sarrawak. *Lamiopsis* has not been recorded from Australia. Several specimens of *Glyphis* (probably *Glyphis.* sp. B) were taken in the Kinabatangan River, Sabah following earlier captures of this species from the same area in 1997 (Manjaji 2002). *Glyphis* was originally reported from Australia in 1982 when two specimens of *Glyphis* sp. A were taken in the Bizant River, Queensland. In the 20 years from 1982, fewer than 20 specimens were recorded from Australia with all records coming from the Northern Territory. These included an additional species *Glyphis* sp. C that differs in vertebral counts, colour pattern on the head, and a number of other characters. However, in the last 12 months an additional 75 *Glyphis* have been recorded from across northern Australia. These have come from research surveys as well as from observer coverage on some inshore fisheries. We will compile and present information on the distribution and size composition of both *Glyphis* species in northern Australia, and make some observations on their abundance and habitat requirements in certain locations. We will discuss the potential impacts of fishing and habitat modification on these species.

SAWFISH (*Fa pristidae*) CATCH DATA IN NORTHERN AUSTRALIAN WATERS: A DESKTOP STUDY

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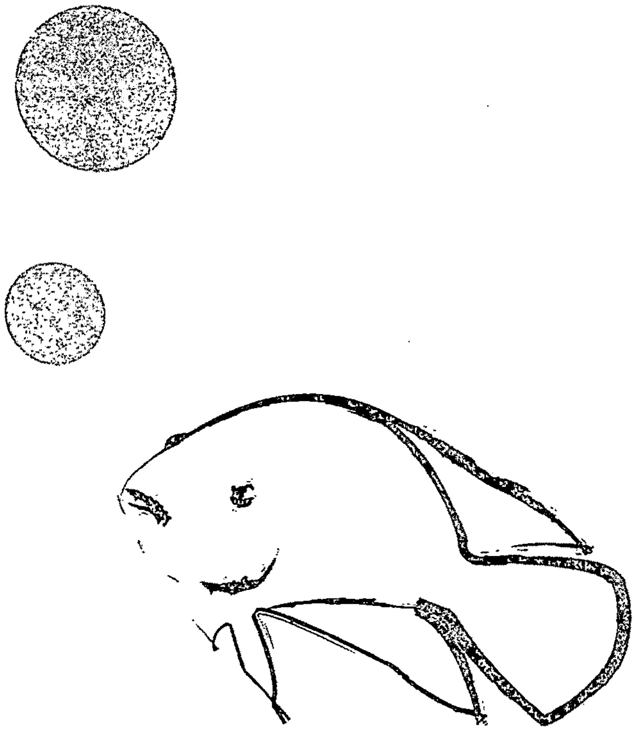
A desktop study was undertaken to compile all available sawfish catch data in northern Australian waters, possibly the last stronghold for sawfish populations in the region and globally. Northern Australia has the highest sawfish diversity in the world, with four species of sawfish in two genera, inhabiting coastal environments from freshwater to the upper continental slope. Local historical data indicate a major decline in catch of sawfishes as a group in the last fifty years. Recent concerns over the vulnerability of remaining populations has resulted in an increase of monitoring by some fisheries, the data indicating that sawfishes consistently appear as a component of bycatch in both inshore and offshore environments. Despite this increase in monitoring, there is little species-specific information available, particularly for inshore marine environments where habitat partitioning of sawfishes is least understood. The study describes available data, and identifies priorities for research and monitoring in assessing the viability of populations of sawfishes in Australian waters.

SS Restocking and Stock Enchancement of Coastal Fisheries:

Potential, Problems and Progress



LESSONS LEARNED FROM 30 YEARS OF RESTOCKING AND STOCK ENHANCEMENT OF MARINE INVERTEBRATES

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A recent review of >1000 published papers has demonstrated that releases of cultured marine invertebrates into fished 'stocks' have been done for two purposes: to restore spawning biomass of badly depleted populations to more productive levels ('restocking'); or to increase production from 'healthy' fisheries by overcoming recruitment limitation ('stock enhancement'). This literature provides many seminal lessons. These fall into those common to both restocking and stock enhancement, and those specifically for restocking or stock enhancement.

Lessons for both restocking and stock enhancement: 1) Interventions need to be made at the level of self-replenishing populations, and such populations often occur at surprisingly small scales 2) Experiments to test methods can give misleading results unless they are done at adequate scales. 3) Success at one location is no guarantee that the methods can be transferred to other sites. 4) Predation is the greatest hurdle to successful establishment of cultured juveniles in the wild. 5) Aquaculture will create opportunities for restocking and stock enhancement but availability of propagation methods does not mean that they can be applied cost-effectively. 6) Large-scale releases of hatchery-reared juveniles can affect genetic diversity of wild populations. 7) The benefits of releasing hatchery-reared juveniles will be reduced unless they address the most urgent needs of the fishery, and appropriate management measures are used. 8) Costs can be reduced through adaptive management.

Lessons for restocking: 9) Costs and timeframes for restocking can be prohibitive and so releases cannot be relied on to correct severe abuses to a fishery. 10) Relocation of adults is a cheaper, effective way of restocking some species. 11) Costs of releasing some species can be defrayed by combining the nursery phase with commercial aquaculture operations.

Lessons for stock enhancement: 12) Very large numbers of juveniles are usually needed. 13) Wild spat can provide an abundant, low-cost source of juveniles for some species. 14) Excessive releases cause density-dependent mortality. 15) Artificial habitats can be used to increase the carrying capacity of the ecosystem for released juveniles. 16) Yields of some species can be increased simply by providing suitable settlement surfaces. 17) Harvests can be improved by redistributing juveniles from areas of heavy settlement to places where they failed to settle. 18) Large areas are needed for stock enhancement of some species. 19). The most successful programmes have been run by co-operatives and the private sector. 20) Successful stock enhancement may change the market conditions for target species.

THE IMPORTANCE OF IDENTIFYING SPATIAL POPULATION STRUCTURE IN RESTOCKING AND ENHANCEMENT PROGRAMS

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Some animal species show little or no detectable genetic differentiation over large areas, but most show significant differentiation. The extent and pattern of this inter-population differentiation varies considerably among species. Some show gradual, isolation by distance variation, some show chaotic patchiness, and some show relative uniformity over large distances with striking discontinuities over short distances. These varying patterns reflect both the dispersal powers of the organism and its population history, and are revealed through examination of nuclear DNA or mitochondrial DNA makers. The evolution of locally adapted genotypes will be facilitated in populations with restricted gene flow, and such co-adapted genotypes may vary from population to population depending on local selective forces.

Restocking and enhancement programs need to be aware of the stock structure of the target species, as the introduction of genotypes unrepresentative of the enhanced population can cause deleterious effects through outbreeding depression. Swamping the native population with large numbers of genotypes from a few matings, even if the broodstock were originally derived from the native population, can also cause deleterious effects, this time through inbreeding depression. It follows that wherever possible, restocking and enhancement programs should use broodstock taken directly from the population to be enhanced, and that large numbers of broodstock should be used. Where this is not possible, broodstock should be taken from the genetically most similar population available. Restocking and enhancement programs should be genetically monitored to determine the impacts and outcomes of the programs.

A METAPOPULATION IN A LARGE PELAGIC FISH? STOCK STRUCTURE IN NORTHERN AUSTRALIAN NARROW-BARRED SPANISH MACKEREL, INDICATED BY GENETICS, OTOLITH ISOTOPE RATIOS AND PARASITES

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We examined several hypotheses about the stock structure of narrow-barred Spanish mackerel, *Scomberomorus commerson*, using different methods to provide information at a range of temporal scales: allozyme and mitochondrial DNA genetic techniques, whole otolith oxygen and carbon isotope ratios, and parasite loadings were analysed for samples taken across Australia's north, and from west Timor (Indonesia). Spanish mackerel are the basis of valuable fisheries throughout the warmer waters of the Indo-West Pacific. An understanding of stock structure is important to identify responsibility for management of straddling stocks in the region of northern Australia, and for ensuring that assessment and management actions are matched in temporal and spatial scale with the spatial dynamics of the fished species.

Fish were sampled in 1998 and 1999 from eight evenly-spaced locations along the northern Australian coastline between south-east Queensland in the east and Shark Bay in Western Australia. There was strong genetic separation between east coast and northern Australia stocks, with a discrete genetic stock in the Torres Strait area between. Narrow-barred Spanish mackerel are large, active, schooling predators that are open water, broadcast spawners with high fecundity. Typical interpretation of these attributes might suggest a well-mixed stock over large spatial scales (eg. northern Australia). However, the same samples, with additional samples taken at much finer spatial scales, were examined using the otolith isotope ratio method. This indicated minimal mixing between adult *S. commerson* at scales ~ 100 km. Parasite studies not only supported this result but also indicated that the degree of seasonal mixing (eg spawning aggregation) is small. Northern Australian *S. commerson* populations probably consist of a mosaic of small functionally distinct assemblages, connected by larval and juvenile interchange at low levels, and only a small degree of adult mixing: a metapopulation.

It is important to match management actions to the appropriate spatial dynamic scales. Management of *S. commerson* fisheries must be designed to accommodate the risk of depletion of assemblages at small spatial scales, with unknown rates of re-colonisation, the extent of retention of larvae and juveniles in natal populations, and adaptation at the scales of the assemblages.

POPULATION DYNAMICS OF FISHERIES STOCK ENHANCEMENT

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The population dynamics of fisheries stock enhancement, and its potential for generating benefits over and above those obtainable from optimal exploitation of wild stocks alone are poorly understood and highly controversial. I extend the dynamic pool theory of fishing to stock enhancement by unpacking recruitment, incorporating regulation in the recruited stock, and accounting for biological differences between wild and hatchery fish. I then analyse the dynamics of stock enhancement and its potential role in fisheries management, using the candidate stock of North Sea sole as an example. Enhancement through release of recruits or advanced juveniles is predicted to increase total yield and stock abundance, but reduce abundance of the naturally recruited stock component through compensatory responses or over-fishing. Release of genetically maladapted fish reduces the effectiveness of enhancement, and is most detrimental overall if fitness of hatchery fish is only moderately compromised. As a temporary measure for rebuilding of depleted stocks, enhancement cannot substitute for effort limitation, and is advantageous as an auxiliary measure only if the population has been reduced to a very low proportion of its unexploited biomass. Quantitative analysis of population dynamics is central to the responsible use of stock enhancement in fisheries management, and the necessary tools are available.

MERITS OF RESTOCKING AND OTHER FORMS OF MANAGEMENT FOR RESTORING SEVERELY OVER-EXPLOITED FISHERIES FOR TROCHUS *Trochus niloticus* AND SANDFISH *Holothuria scabra*

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An important goal of fisheries management is to ensure that fish stocks are harvested at sustainable levels. Despite this, fishing has caused the decline of many fish populations worldwide. Restocking with hatchery-produced juveniles is one of several tools available for restoring depleted populations of fished species and should be evaluated with other management measures such as minimum size limits, harvest controls and closures before being implemented. The rate at which a depleted population recovers in response to a particular management intervention depends on its demographic characteristics (longevity, age at maturity and age-specific mortality rates) and on rates of natural recruitment, as well as other factors. Two issues in relation to restocking are addressed here. First, it is shown that populations that are readily over-fished are not necessarily recruitment rate-limited, and that, therefore, restocking may not be an appropriate means of regenerating easily depleted populations. Second, the rate at which a depleted population may regenerate in response to management intervention, including restocking, is assessed with reference to the stock-recruitment relationship (SRR), larval stage characteristics and hydrology. The merits of restocking and other management measures for sedentary marine invertebrate species are then evaluated using a comparative analysis of two commercially important marine invertebrate species: a gastropod mollusc (*Trochus niloticus*) and a Holothurian (*Holothuria scabra*).

NO-TAKE-ZONES FOR RESTOCKING OF THE SEA CUCUMBER *Holothuria scabra* DEFINED THROUGH MODELLING OF MOVEMENT DYNAMICS

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Sea cucumbers are a valuable, yet depleting, artisanal fisheries resource. Research on the most valued of tropical species, the sandfish *Holothuria scabra*, has supplied methods for culturing juveniles and releasing them into the wild for restocking. Of importance are the optimal strategies of where, when and how to release the hatchery-produced juveniles and the spatial design of releases.

Stock enhancement (as a 'put-and-take' approach) would involve spreading juveniles over large areas. In contrast, restocking to rebuild breeding populations should involve releases at higher density into smaller areas defined as No-Take-Zones. This would concentrate the surviving animals for improving reproductive success once they reach maturity. Sandfish are slow movers but will disperse from release sites while they grow to maturity. Thus, No-Take-Zones should comprise the release site and a buffer zone around this site, in order to protect the released stock from being fished. Likewise, assessing restocking success, in terms of proportionate survival of released animals, is predicated on the knowledge of their movement, or dispersal, after release.

To examine the dispersal of released sandfish, hatchery-produced juveniles (1-105 g) were released within a shallow sea grass habitat in New Caledonia. The movement paths of the juveniles and wild adults were assessed at different times of the day. The speed of sandfish movement was related to their size, and movement was directionally random. To estimate the dispersal of sandfish from release sites over time, the field data were fitted to a random-walk diffusion model including an expression to account for the estimated relationship between movement velocity and animal size. The Eulerian-model estimates of random diffusion from release sites were calculated for different durations.

Where release sites are within a suitable unbounded habitat, the simulation proposes the size of buffer zones that should be added to the release area for delineating No Take Zones to ensure that 90% stay within the boundary of the No Take Zone. Bounded habitats, such as bays and habitat edges that deter emigration, should be taken into consideration in the dimensioning of No Take Zones. Likewise, survey areas for assessing restocking success should be expanded over time to account for dispersion effects, particularly when absolute survival is to be estimated. Advantages of sea pens for restocking of sea cucumbers are discussed in relation to the movement dynamics of sandfish and the dimensions of No Take Zones.

FISH HEALTH MANAGEMENT IN MARINE STOCKING PROGRAMMES

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In light of limited supplies of fish from natural populations, stocking is one of the means to meet the demand for seafood products from an ever-increasing human population. Fishery enhancement technologies are common management practices throughout the world: the technology to produce large numbers of early-life stage aquatic organisms in hatcheries is well-developed, and the use of alien species, although controversial, is common in marine and inland areas. However, these practices require technical interventions in the rearing process of aquatic organisms that may substantially change how an organism interacts with the natural environment, the culture environment, and with other species. These changes also influence how an organism interacts with pathogens. Certain organisms (bacteria, virus, fungi and parasites) which may not be pathogenic under normal environmental conditions (in the presence of native species) could become pathogenic and may cause problems in enhancement programmes. Therefore, responsible stocking programmes must address fish health management concerns.

Fish health management in stocking programmes involves:

- the source of material to be stocked, which may be raised in a hatchery or collected from the wild, and it may be a native or alien species;
- the populations to be managed, which include the hatchery, native, and enhanced (wild + hatchery) populations;
- risk management, which includes risk assessment (probability and severity of disease outbreak), quarantine, diagnostic and treatment procedures, and mitigation measures;
- monitoring and reporting of fish health status and standards of hatchery, wild and enhanced populations.

Special consideration should be given to trans-boundary movements of aquatic species and associated pathogens. Substantial losses to the fishing and aquaculture industries have resulted from the inadvertent introduction of exotic pathogens in fishery enhancement programmes, e.g. *Gyrodactylus salares* parasite introduced into Norwegian waters through stocking of Atlantic salmon from Sweden.

The importance of fish health management, especially the need for accurate diagnosis, quarantine, certification, monitoring, and regional cooperation has been recognized by national and international organizations, and development agencies. Mechanisms that include the FAO Conduct for Responsible Fisheries, the ICES code of practice on introductions, Asian regional guidelines on fish health, the Beijing Consensus on fish health, and the agreements of OIE/WTO are presented in an overall framework for responsible fish health management in marine stocking programmes.

SUCCESSFUL STOCK ENHANCEMENT OF THE JAPANESE SCALLOP *Patinopecten yessoensis* IN HOKKAIDO

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The scallop fisheries in Japan have been based mainly along the coast of the Sea of Okhotsk Coast since the early 1900s. Peak annual production reached several tens of thousands of tons in the 1930s'. However, annual production decreased to minimal levels from the mid 1940s until the early 1970s due to overfishing. Then, the novel method of covering spat collectors with a net, developed in Mutsu Bay, Aomori Prefecture in 1964, was used to catch and grow unprecedented numbers of spat. The result was a rapid increase in the production of scallops.

The activities of the Sarufutsu Fisheries Cooperative provide a prime example of how the capture and culture of spat restored a depleted local scallop fishery. The cooperative organised a mass-release of scallop ‘seed’ produced at a low price, supported by logistic and technical advice from research organizations. The fishery based on mass-release of the seed was managed using measures such as exclusion of predatory starfish, and rotational harvesting. The rotational harvesting system involved dividing the fishing grounds into four areas, releasing one-year old seed into each area sequentially after exclusion of predators, then harvesting areas with four-year old scallops three years later. As a result of trial and error over several years, the system for managing the scallop fishery used by the cooperative is producing stable yields of ca. 40,000 tons per year.

This management system then spread rapidly to neighboring cooperatives and production of scallops in Hokkaido increased remarkably. Management now incorporates estimates of environmental carrying capacity (supply of food sources), and the fishing grounds have expanded to deeper areas. For example, the Tokoro Fisheries Cooperative has extended its fishing grounds to a depth of 70 m; seed are released at a mean density of 7.16 individuals/m^2; and a mean density of 4.26 scallops/m^2 is harvested at an average shell weight of 200 g after three years. The recapture rate of the seed is as high as 60%.

In 2001, production of scallops in Japan based on release of cultured juveniles on the seabed was 291,000 tons, with a value of 43,300 million yen. When combined with the production of 235,000 tons, worth 34,900 million yen, from aquaculture in hanging nets, the total production of scallops in 2001 was 526,000 tons. The harvests of scallops accounted for almost 9% of Japan's total fishery production of 6,120,000 tons. The factors leading to the success of the scallop fishery in Hokkaido are presented in detail.

LESSONS LEARNED FROM JAPANESE MARINE FINFISH STOCK ENHANCEMENT PROGRAMS

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According to the latest release statistics, a total of 75.76 million juveniles from 37 finfish species were produced in hatcheries and released into Japanese coastal waters in 2002. The top five species were Japanese flounder *Paralichthys olivaceus*, red sea bream *Pagrus major*, Japanese sandfish *Arctoscopus japonicus*, black sea bream *Acanthopagrus schlegeli* and Pacific herring *Clupea pallasii*, which account for 80% of the total. Among these, Japanese flounder and red sea bream have been the major species for Japanese marine stock enhancement programs, and have been released throughout Japan.

Sampling surveys of commercial landings at fish markets conducted since the 1980s have revealed that released juveniles survive and contribute to overall fishery production. However, it is unknown whether stocking programs have augmented the total net production without also having had a negative impact on wild fish populations. The main concerns about stocking are the replacement of wild fish and genetic impacts on wild populations. In dealing with these concerns, testing the augmentation hypothesis using real data is most important, even essential, in judging whether juvenile release programs are an effective tool for stock management.

Catch increments, above the level at the commencement of release, may be a simple measure of augmentation success. For Japanese flounder in the Seto Inland Sea (SI) and Hokkaido (HK) regions, catch statistics showed a clear increase after release, while in the other regions the total catch has not increased or has recently decreased, suggesting that the stocking programs failed to augment total production. For red sea bream, the total catch increased in SI, the northern Japan Sea (NJ) and south Pacific (SP) regions, while in the other regions, total catch did not increase, suggesting the failure of the stocking programs in these regions (Fig. 1). In the north Pacific (NP) region, juveniles have not yet been stocked. In this study, I evaluate through several case studies whether stocking programs have augmented total production. I also discuss situations in which stocking could be used as a tool for stock management.

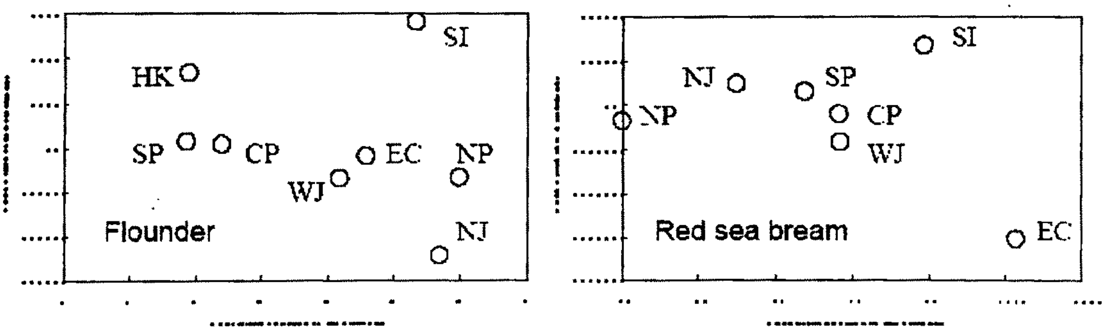

Figure Relationship between total number of juveniles released from 1977 to 2001 and catch increment at 2001 after release for Japanese flounder and red sea bream. HK (Hokkaido), NJ (northern Japan Sea), WJ (western Japan Sea), NP (north Pacific), CP (central Pacific), SP (sourth Pacific), SI (Seto Inland Sea), EC (East China Sea).

ACHIEVEMENTS AND LESSONS LEARNED IN RESTOCKING GIANT CLAMS

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The effort leading to the restocking of giant clams (Tridacnidae) in the Philippines may be traced back twenty years ago with the ACIAR-funded regional project on the culture of these bivalves. The proposal originally packaged by the WorldFish Center (then ICLARM) involved several countries in the South Pacific plus the Philippines. One of the objectives of the project was the restocking of giant clams, following the development of the culture techniques. This paper presents the "achievements and lessons learned in restocking giant clams" in the Philippines, reputedly the only country among the original participants to further this objective in a significant way.

Following the development of culture techniques, the initial efforts were to begin to produce several species of tridacnids in sufficient quantities for both conservation and for consumption. Exploratory trials were initiated to interest municipal fishers to grow out clams for their use and for restocking. The hope was that the clams they would grow out would be marketed overseas for the aquarium trade where the benefits would greatly outweigh the costs of culturing the clams, with a small percentage of the clams to be used for restocking reefs. The initiative to involve locals ran into legal obstacles when the government regulatory agency prohibited the export of cultured clams, regarding this as a threat to the conservation of wild individuals. In addition, there was little interest from the government to pursue pilot studies on clam farming.

With this avenue for development closed, the restocking effort had to rely heavily on conservation projects. Hence, there have been starts and stops to the effort, but with the determination to forge ahead, the Marine Science Institute has managed to distribute and disperse large numbers of giant clams in all the major regions of the country. Initially working with the available species, notably *Hippopus hippopus, Tridacna derasa, T. squamosa, and T. maxima,* the institute shifted emphasis to the true giant clam, *Tridacna gigas,* principally through the use of this species in the Pew project of the first author entitled "Coral Reef Habitat and Productivity Enhancement through Coral Transplantation and Giant Clam Restocking."

Some 20,000 *T. gigas* have been dispersed through two projects, the Pew project mentioned above and the "Enhancement of the Hundred Islands National Park through Giant Clam Mariculture and Reseeding," in addition to an equal number distributed through other means. Another 20,000 of the smaller species have been distributed with modest success. All these have been restocked in more than 40 sites throughout the country.

As a possible portent of changing policies, the government has begun to allow the exportation of cultured clams for research and restocking purposes. Consequently, about 2,000 cultured *T. gigas* and *T. squamosa* have been sent to Japan, Malaysia, and Singapore.

THE CAUSES AND CONSEQUENCES OF ENHANCEMENT OUTCOMES: SOCIO-ECONOMIC LESSONS LEARNED FROM INLAND FISHERIES IN SOUTHEAST ASIA

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Experiences of stocking ventures in inland fisheries have shown that whilst stocking has the potential to yield substantial benefits, the actual outcomes (in terms of for example, yields, benefit distribution and institutional sustainability), are often different from those initially expected. This is in part due to the complexity of the environments into which enhancements are introduced, involving dynamic interactions between the biological characteristics of the resource, the technical intervention of enhancement *and* the people who utilise or manage it. The biological outcomes of enhancement obviously have social and economic consequences and understanding these has become an important area of enhancement research. However, less well studied is the extent to which these outcomes have social and economic causes.

This paper highlights lessons learned in both of these areas, drawing from long-term research on community-based small waterbody enhancement in the Lao PDR. Firstly, it describes how enhancement can impact on peoples' command (access, use, control) over living aquatic resources, and consequently the benefits that different users, in particular those from different socio-economic groups, can derive from enhancements. Secondly, using the Lao case study as an example, it demonstrates how yields achieved from stocking initiatives can only be understood in the context of the characteristics of the user community and, consequently, the way they choose to manage and utilise the resource. The implications of these findings for those involved in enhancement research and development in both inland and coastal areas are discussed.

RECREATIONAL ANGLERS' WILLINGNESS TO PAY FOR INCREASED CATCH RATES OF PACIFIC THREADFIN *Polydactylus sexfilis* IN HAWAII

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The social value of a potential stock enhancement program for Pacific threadfin (*Polydactylus sexfilis*) in Hawaii is evaluated in terms of demand for fishing quality improvements by recreational anglers on the windward coast of Oahu, Hawaii. Contingent valuation is used to estimate willingness to pay for increased fish catch rate resulting from a subsidized stock enhancement program. The empirical results of the study indicate that the current catch level, employment status, occupation, education, gross income, and extra catch are important determinants of net willingness to pay for Pacific threadfin abundance. A tobit model is constructed to identify the net willingness to pay for increased fish catch rates. The estimated net willingness to pay for the average catch rate of 3.8 fish per trip is US$7.95. Estimates of net willingness to pay for the average current catch rate plus the current average catch increment of 1, 3, 9, and 11 fish per trip are US$10.05, 13.67, 19.95, and 20.52, respectively.

STOCK ENHANCEMENT IN TAIWAN

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Stock enhancement and sea ranching programs have the potential to enhance fisheries production and, therefore, contribute to food security. In Taiwan, it was in late 1987 when an integrated program on stock enhancement and sea ranching was developed although artificial reefs were constructed and cast as early as 1973. In 1976, the stocking of hormone-induced adult Japanese eel (*Anguilla japonica*) was started while adult grass prawns (*Penaeus monodon*) were stocked beginning in 1985. Most of the stock enhancement and sea ranching activities have resulted from the development of mass-propagation techniques of many fish and crustacean species. Until 2000, a total of 83 million seeds (11 finfish, 6 crustaceans, and 5 mollusks) were released. Most recently, old fishing vessels, electric poles and car tires have been cast as artificial reefs. Since 2000, outmoded warships were bombed down offshore and used as artificial reefs for stock recruitment. Recreational facilities along beaches have also been constructed as a way to promote the people's appreciation for nature, especially of the seas and oceans, and also for cultural and spiritual gratification. In this manner, the people would also develop awareness regarding the importance of preserving nature and become more actively involved in relevant projects.

The only draw-back of stock enhancement and sea ranching programs in Taiwan is the lack of proper assessment, and that very few assessments were done after the release of stocks. Recently, a project was being undertaken to assess the population dynamics of *Penaeus monodon* broodstocks in Taiwan, which will analyze the effect of the intensive aquaculture operations, release of animals in the wild, as well as its effect on genetic diversity. This effort should be followed for other species being released for stock enhancement and sea ranching purposes.

In order to realize the potential of any stock enhancement and sea ranching program, it should show that the stocked species add to recruitment and does not displace the native stock, the carrying capacity of the habitat is not exceeded, and the natural biodiversity is not endangered. Since stock enhancement and sea ranching programs partly depend on aquaculture for its reliable supply of seed, aquaculture itself must be carried out in harmony with the environment. Considering both stock enhancement and sea ranching and aquaculture as components of integrated resource management is advisable. The benefits from stock enhancement and sea ranching programs, such as that of averting food crisis, may be better gained by strengthened international cooperation and promotion at the regional level. Current advances must be more widely disseminated and research on wider geographic scale must be conducted. Side by side with environmental and biological research, legal and socio-economic aspects, education, training and outreach should receive more emphasis.

STOCK ENHANCEMENT PROGRAMS OF KURUMA PRAWN *Marsupenaeus japonicus* IN JAPAN: STOCKING EFFECTIVENESS AND RELEASE STRATEGY

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Kuruma prawn *Marsupenaeus japonicus* is one of the most important fishery resources in Japan. Stocks of Kuruma prawn decreased during the late 1960s caused by the loss of nursery grounds resulting from the destruction of the environment by tidal land reclamation and water pollution. Kuruma prawn stock enhancement programs were initiated in 1964 by the Japanese Fisheries Agency in the Seto Inland Sea. Hatchery technologies for this species, which had been developed for aquaculture, were applied to the production of juveniles for stocking in natural habitats. Since 1964, annual numbers of juveniles released in Japanese coastal waters have greatly increased to approximately 300 million (Figure), with stock enhancement programs being undertaken all over the country, except in Hokkaido in the northern most part of Japan.

A series of scientific surveys has been conducted to evaluate the effectiveness of stocking Kuruma prawns. However, these surveys could not make a quantitative evaluation of the survival of released juveniles as tags with high retention rates were not available, and no natural marks to distinguish released individuals from wild ones in the landings, such as those that occur in several hatchery-produced fish fry species, e.g., black pigmentation on the eyeless side of the Japanese flounder *Paralichthys olivaceus*, have been found for Kuruma prawns.

To overcome these problems, in 1995 Japanese scientists decided to use coded wire tags for marking juvenile prawns. In the same year, a new cost efficient marking method was developed, i.e., uropod clipping, since regenerated uropods show less pigmentation than normal ones. These marking methods were applied in surveys to evaluate stocking effectiveness and, eventually, quantitatively to estimate recapture rates of stocked prawns. In this paper trends in the fishery and release statistics of Kuruma prawns is presented, and the results of recent marking surveys for estimating recapture rates of released juveniles are reviewed. Release strategies for successful stocking and stock management of the species are also discussed.

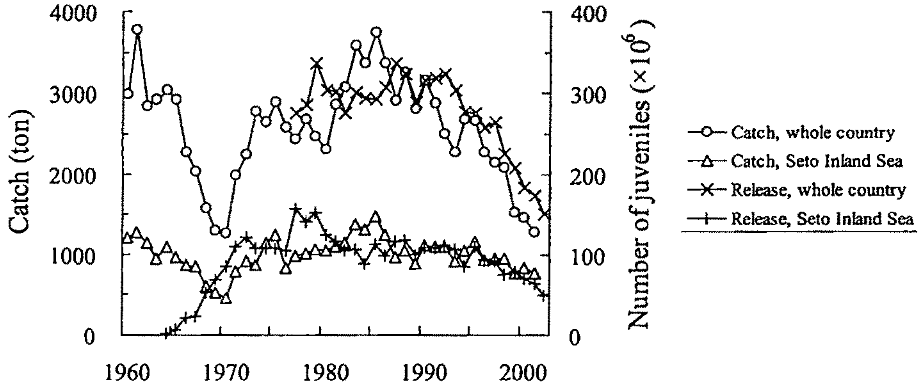

Figure Changes in annual catches and numbers of released juveniles of Kuruma prawn in the Seto Inland Sea and the whole of Japan. Release statistics for all parts of the country have been published from 1977.

STOCK ENHANCEMENT AND TRANSPLANTATION OF MARINE SHRIMP *Fenneropenaeus chinensis* IN CHINA

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The marine shrimp, *Fenneropenaeus chinensis,* is indigenous to the Bohai and Yellow Seas. The highest catches of this species (40 000 tons) were recorded in 1979, but have declined since then because of over-fishing and environmental problems. Stock enhancement and transplantation of this species has been practiced since the 1980s to increase production of the resource, and some significant economic gains have been achieved. This paper briefly reviews the history and current status of the fishery, and the technical aspects of stock enhancement and transplantation, including selection of appropriate sites and times for releasing hatchery-reared juveniles, release size and stocking density. Many factors such as water temperature, predator density and size at release affect the efficiency of releasing and transplanting *F. chinensis* in China. Techniques used to evaluate the success of enhancement and transplantation included differences in the distribution of length frequencies of naturally recruited and released shrimp (Fig. 1), and the relative abundance index.

The recapture rates of *F. chinensis* released into Xiangshan Bay, a semi-closed bay in Zhejiang Province where this shrimp does not occur naturally, varied from 6.8% to 13.3% between 1986 and 1990. For juveniles with a body length > 30 mm, the average recapture rate was 9.1%. This increased to 9.41% during 1991-1995 (range 8.18%-10.17%), although the catches also included some resident shrimp released during the previous years. Recapture rate dropped to 0.2-0.3% when post-larval shrimp with a body length of ~10 mm were released. In the "closed" bay of Dongwuyang in Fujian Province, the average recapture rate was 5.3% (range 3.08-7.76%) during 1986-1992, when shrimp with a body length ranging from 8-15 mm were released. However, in 1993, the recapture rate was increased to 8.15% by releasing juveniles with a body length of 35-42 mm. In the Haiyangdao waters of the Northern Yellow Sea, recapture rates of 5% were achieved by releasing shrimp juveniles with a body length of 10-12 mm directly after acclimation in the earthen ponds. A different species of shrimp, *Marsupenaeus japonicus*, was transplanted in 1996 in the eastern waters of the Laizhou Bay, where it does not occur naturally. The recapture rate of this species reached 12.5% for juveniles with an average body length of 9.9 mm.

The constraints and problems hindering the development and prospects of marine shrimp stock enhancement and transplantation in China are further discussed.

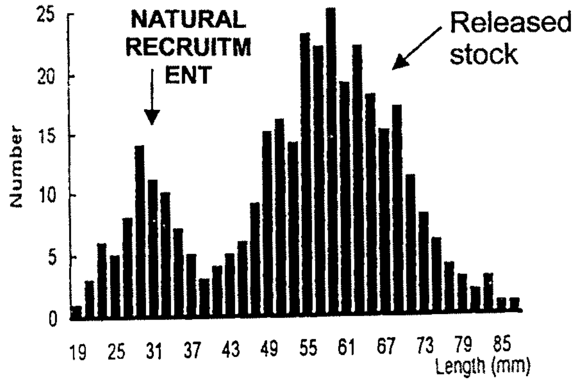

Fig. 1. Statistics of distribution of body length frequency shows natural and released stocks.

NEW DIRECTIONS FOR RESEARCH IN PRAWN (SHRIMP) ENHANCEMENT: EXPERIENCE FROM EXMOUTH GULF, AUSTRALIA

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Despite attempts in many countries, large scale prawn (or shrimp) enhancement has only been reported over many years in Japan and China. In these countries, prawn stock enhancement has been possible because of the capacity to produce large numbers of small individuals for release. While exploring the feasibility and bio-economics of tiger prawn (*Penaeus esculentus*) enhancement, recent research in Exmouth Gulf endeavoured to take a whole of enhancement system approach in a region where there was no large scale existing prawn aquaculture industry. This approach included developing a framework for the bio-economic evaluation and risk assessment for all components of a stock enhancement operation i.e. hatchery, grow-out, identifying release sites, population dynamics, fishery and monitoring. This research identified that, on the basis of current knowledge, the probability of making a "profit" from enhancement was only about 36% and that significant capital investment would be required to produce the estimated 24 million juvenile prawns required for a 100 tonne catch of enhanced prawns. However, these predictions were made with great uncertainty in post-release mortality and no data on the optimal release strategies for prawns. Ecological studies of *P. esculentus* in northern Australia show that growth varies greatly between different nursery habitats (seagrass). Laboratory studies have shown that the survival of *P. esculentus* from fish predation is also strongly influenced by type of nursery habitat. Data from these studies were used to simulate the success of releases in different habitats. The results from these simulations, and those from other species e.g. striped mullet, suggest that post-release survival depends on the release habitat, release time and size-at-release, and that knowledge of these factors is critical to the bio-economic evaluation of enhancement and its likely success.

POTENTIAL FOR ENHANCING SPINY LOBSTER PRODUCTION IN AUSTRALIA THROUGH THE CAPTURE OF PUERULUS LARVAE FOR ONGROWING AND RELEASE

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Aquaculture of rock lobster has commenced in Tasmania, Australia with several small-scale commercial operations capturing puerulus from the wild. Due to the longevity and complexity of the larval life, it is expected that the only source of post-larvae for the foreseeable future will be through this wild capture.

The harvest of puerulus from the wild was of concern to the managers of the fishery and there was agreement that a compensation mechanism was required to protect wild stocks. Options included buying effort or quota out of the fishery, which could then be converted to puerulus harvest, or alternatively, a system termed "reseeding". Reseeding involved ongrowing puerulus in culture for one year and then releasing a proportion to account for those that would have survived naturally. The key to this option was that survival in captivity was much higher than in the wild so that it became possible to both enhance coastal reefs with juveniles released after 12 months and also retain animals for ongrowing.

Advantages of reseeding over a buy-out of fishing effort were that: (a) at worst the economic benefit of the fishery should be maintained, and there is potential for direct fishery enhancement; (b) there was no reduction in egg production of sub-legal females; and (c) there was no concern regarding regional impacts of displacement of effort as juveniles are returned to the same location from where puerulus were extracted. In addition, there was no need for a limit on the number of puerulus that could be harvested and there was no economic drain on start-up aquaculture companies in buying effort or quota from the fishery. Research projects have addressed numerous issues relating to this operation including: (a) the behavioural competency of juveniles released to the wild (including social intra-species interactions, feeding behaviour, and predator response behaviour); (b) movement and dispersal after release; (c) survival after release; (d) impact of release habitat; (e) health assurance and risk of disease spread; and (f) release protocols such as timing of release in relation to activity patterns of predators.

Survival of southern rock lobsters in enhancement operations appeared to be high and could be optimised by simple protocols during release.

Methods developed for enhancing lobster fisheries with juveniles are now being applied to the translocation of adult lobsters in areas with spatial management problems. For example, shifting lobsters from areas of high density/slow growth to areas of low density/high growth. Pilot trials by industry have indicated that this may provide one of the largest opportunities for expansion of production of the Tasmanian fishery.

CONTRIBUTION OF STOCKED MUD CRAB *Scylla paramamosain* TO COMMERCIAL CATCH ESTIMATED BY GENETIC STOCK IDENTIFICATION

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In Japan, there are three areas where more than one metric ton of mud crabs (*Scylla paramamosain)* are captured every year. In these places, mud crabs are an important fishery resource and the price is high. In one of these areas, Urado Bay in Kochi Prefecture, releases of hatchery-reared juveniles have been made from 1986 onwards. The annual catch of mud crabs there has now been relatively stable at about 5 metric tons since 1994, coinciding with the period when annual releases of juveniles generally exceeded 80,000 (Fig. 1).

Estimating recapture rates is indispensable to evaluate the effectiveness of stock enhancement programs, and to do so, it is necessary to develop marking methods that distinguish between wild and reared individuals. The stocking effectiveness of mud crab has been difficult to estimate owing to the lack of an accurate marking method. In this study, a mitochondrial DNA (mtDNA) marking technique was developed to assess the contribution of released juveniles to the total catch.

This technique includes classifying mtDNA into haplotypes based on restriction of the fragment length polymorphism (RFLP) of the D-loop, and using a haplotype with a lower frequency as a mark. The mixture rate of released juveniles in the total catch was estimated genetic stock identification. From 1997 to 2002, annual releases of 72,000-149,000 juveniles, with an average carapace width of 8.5-9.9 mm, were made in Urado Bay in late May. Each year, the haplotype of the released crabs differed. Samples for mtDNA analysis were collected from 300-600 individuals between August and December of each year. The mixture rate of released juveniles in the total catch was estimated by the bootstrap method, using 10,000 time trials, to be 5-19.7%. The contribution of released juveniles to the total catch was estimated to be about 0.5-1 metric ton, or ~10-20%.

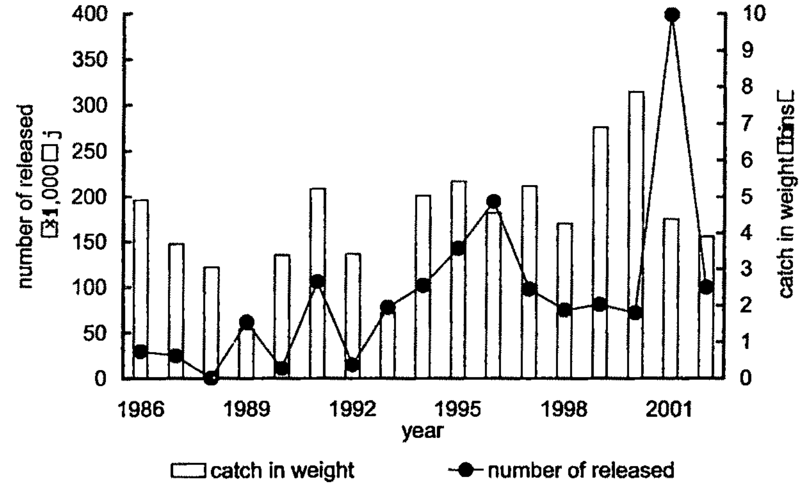

Fig. 1 Changes in annual catch of mud crab, and number of juveniles released, in Urado Bay.

STOCK ENHANCEMENT AND AQUACULTURE OF *ANADARA GRANOSA* (BLOOD COCKLES) IN RELATION TO OTHER COASTAL ACTIVITIES IN PENANG, MALAYSIA

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Anadara granosa (Linnaeus, 1758) (Bivalvia, Arcidae), commonly named blood cockles, occur in the eastern Indian and western Pacific oceans and are particularly abundant along the western coast of peninsular Malaysia in muddy silt-clay sub-tidal substrates. During the past fifty years, Malaysians have developed methods of collecting juveniles in suitable parts of the coastline and transporting these to sheltered bays and channels where they are manually transplanted across intertidal and subtidal muddy flats seaward of mangrove fringing forests. The growing cockles are redistributed after intervals of time and then finally collected. In this way, the blood cockles' survival and growth is enhanced. After harvesting, the adult cockles are washed, sorted and packed in sacks for transportation and sale: significant quantities are exported. Malaysia produces about 80,000 tons of blood cockles per year and is the second largest producer in the world, surpassed only by China.

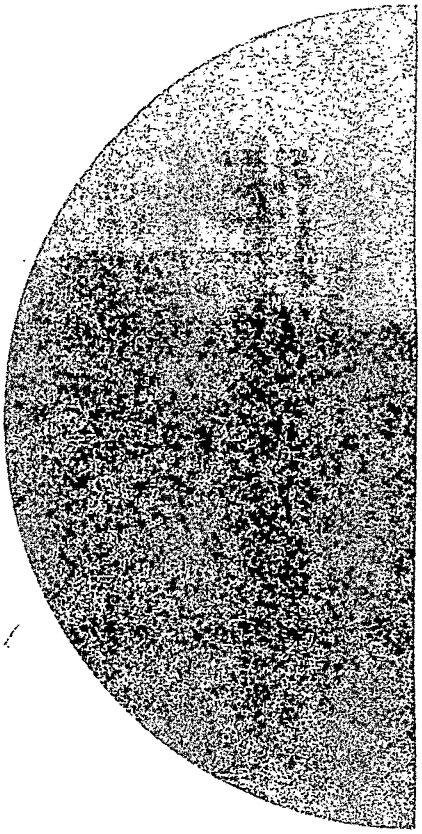
In this study, we investigated blood cockle culture activities along the eastern side of the channel between the island of Penang and the mainland, from the point where the Penang Bridge reaches the mainland at Butterworth, then southwards to the settlements of Juru and Bukit Tambun, and seawards towards the small islands of Pulau Aman and Pulau Gedong.

We examined biological, ecological and socio-economic aspects by observations, collecting samples, accompanying culturists to sea in their work and interviewing local people involved in cockle culture as well as people of the area engaged in other coastal activities. We generated detailed three-dimensional digital maps of the seafloor using a portable GPS unit connected to an echo-sounder, while we simultaneously mapped key coastal water quality parameters (temperature, salinity, dissolved oxygen, pH and oxidation-reduction potential) using a clock-synchronised multi-probe meter. These results are compared with a high-resolution satellite image of the area. We observed other forms of aquaculture, such as fish farming, oyster culture and shrimp farming, along with various activities such as fishing, tourism, shipping and the disposal of domestic sewage along with agricultural and industrial wastes that interact in both positive and negative ways with the culture of blood cockles.

Our results show that streams entering this area are heavily polluted by organic wastes that cause depletion of dissolved oxygen to an extent that is disadvantageous for cockles and other forms of aquaculture (whereas moderate organic enrichment enhances cockle growth). This organic pollution can be clearly discerned on the satellite images as brown discolouration of streams and the formation of black sulphide mud in the intertidal zone and shallow subtidal fringe. We were also concerned about other pollutants and pathogens entering these coastal waters from sewage, industry, agrochemicals and aquaculture.

Our interviews indicate that incomes from cockle production are important for local communities as well as contributing significantly to the Malaysian national economy. Some of the cockle culture activities are carried out by small-scale cooperatives (in Juru), others by larger private operators (in Bukit Tambun) such that benefits are distributed in different ways.

Knowledge of various benign or beneficial interactions and of detrimental conflicts of interest between various forms of resource use, production systems and waste disposal are intended to provide information towards improved planning for coastal zone management and enhancement of sustainable coastal aquaculture systems.



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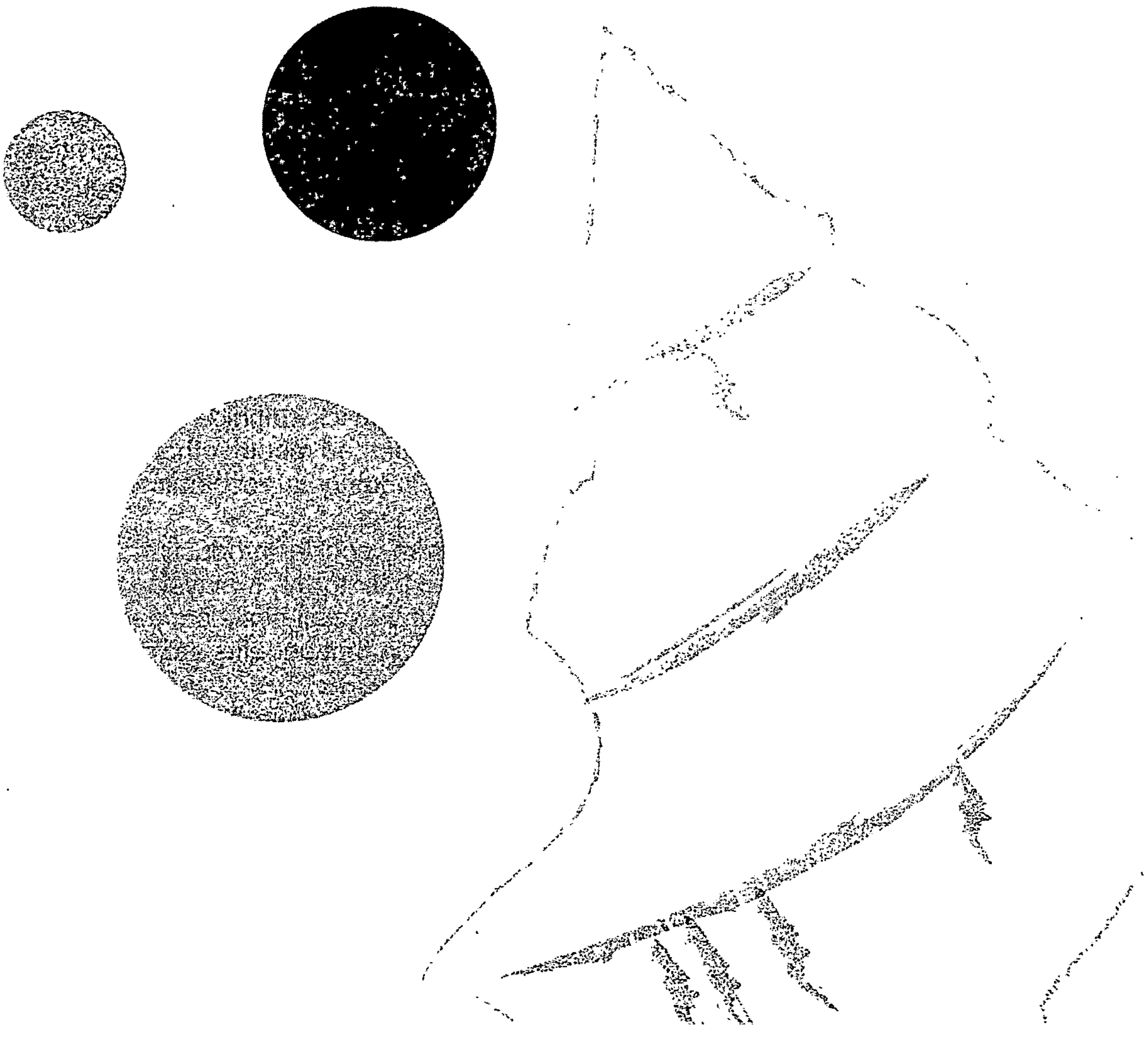

SHORT TERM EFFECTS OF BOTTOM TRAWLING ON FORAMINEFERA AND HARPACTICOIDA ALONG THE COASTAL WATERS OF KERALA (S.INDIA)

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Bottom trawling is one of the most prevalent methods of fishing along Kerala coast in India, with a numerical strength of 4690 trawlers in 2002. A pioneer attempt was made to assess the short term impact of bottom trawling on two important meiofaunal taxa, viz. Foraminefera and Harpacticoida along the Cochin – Munambam region (Long.76°10' 94" to75° 56'00" and Lat. $9^0$58' to $10^0$10') during the period December 2000 to November 2002. The study region was divided into 5 different depth zones, 0-10, 11-20, 21-30, 31-40 and 41-50 m with two stations at each depth, thus comprising a total of 10 stations. A commercial shrimp trawler of 45 feet OAL was used to conduct experimental trawling along this zone. The parameters of bottom waters such as dissolved oxygen, turbidity, temperature, salinity, pH and nutrients viz. nitrite and phosphate were analyzed following standard procedure both before and after trawling. Organic matter and sediment in the mud samples collected from sea bottom were also analysed both before and after trawling. Significant reduction was observed in dissolved oxygen content of bottom waters, while a significant increase was observed in the turbidity after trawling ($P<0.01$). In July 2001, a drastic decline in dissolved oxygen was recorded at bottom at station 2 where 3.98 mg/l oxygen was recorded against 5.10 mg/l before trawling. Highest variations in turbidity were observed at stations 6 and 8 in July 2001 and May 2002 where 38 NTU was recorded after trawling against 10 NTU observed before trawling in July 2001 and May 2002 registering an almost four fold increase in turbidity due to trawling. Nitrite and phosphate ranged between 0.01-3.93 and 0.21-6.56 micromoles/l respectively in samples collected before trawling. Nitrite values recorded in samples collected after trawling ranged between 0.53 and 4.58 while phosphate values recorded with a range of 0.39 to 7.76 micromoles/l. Perceptible changes were not observed in the case of temperature, salinity and pH of bottom waters. The range of organic matter before trawling was 0.22- 7.76% while the range after trawling was 0.13 to 6.87 %, showing a drastic reduction in organic content of sediments collected after trawling. In the samples colleted after trawling, sand content increased by an average of two fold, while the percentage of clay fractions decreased by about 10 fold after trawling. High densities of copepods were recorded in the inshore areas characterized by muddy clay sediment with peat at station 4 (20-30m depth zone) with a density of 3499/10 cm^2. On comparison of this value before and after trawling, variations were insignificant; however a decrease in abundance was noticed. Peak of foraminiferan population was recorded at station 6 in November 2002 with a density of 2,320/10cm^2. In the samples collected after trawling, the maximum number was recorded from the same station with a density of 4,105/10cm^2. While comparing the before and after trawling values, a significant increase was recorded after trawling at stations 5, 6, 7 and 10.

ETHNOMETEOROLOGICAL KNOWLEDGE (EMK) AND FISHING PRACTICES IN PARONGPONG ISLAND, CATANDUANES, PHILIPPINES

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Indigenous knowledge systems (IKS) are now recognized as indispensable tools to achieve sustainable development. IKS is knowledge that people in a community have developed over time and passed on from generation to generation, usually by word of mouth. It is manifested in the form of information, practices, technologies, beliefs, tools, materials, local experimentation, resources, and indigenous education and communication systems. This knowledge represents "nuggets" of wisdom that have evolved, matured and been refined by time in abrasion and familiarity with the forces of nature.

Catanduanes, Philippines lies between 13.5 and 14.1° N and 124.0 to 124.5° E. It is located along the Pacific-side of the Philippines and the typhoon-belt region. The maximum wind speed recorded in the Philippines occurred in Virac, Catanduanes on October 13 1970, caused by Typhoon Sening with a wind gust of 277 km per hour. The unpredictability and climatic turbulence besetting the province is a phenomenon that people in the island province have to live with. In the course of time, familiarity with typhoons and associated events and experiences gained through coping, adaptive and adoptive mechanisms have enabled the people to learn to predict weather by means of signs, symbols, indicators or phenomena. This is ethnometeorological knowledge (EMK).

Fishers in Catanduanes are tremendously affected by typhoons. Consequently, they have their EMK, which enables them to be seafarers amidst turbulent waters and weather conditions This report underscores the fishers' accumulated wisdom about atmospheric conditions and sea turbulence gained while fishing. The knowledge system and practices of fishers who make their living from the sea is presented.

The study identified 21 prevalent types of EMK related to typhoons in Parongpong Island, Catanduanes, Philippines. This EMK predicted the coming of a typhoon and the condition of the sea. Six EMK were manifested reactions of plants and animals observed by the fishers related to a looming typhoon and consequent turbulent sea conditions. Distinct changes in the environment and atmospheric conditions every time a typhoon is threatening were embodied in the EMK of the fishers. They likewise recognize the coming of a storm through their senses. Two EMK were related to season and disastrous experiences of the fishers. The sources and accuracy of EMK were established in the study. Twenty (95%) of the prevalent EMK were perceived to influence fishing trips. The socio-demographic and economic characteristics of the fishers and their families were profiled in the research.

The study established that indigenous knowledge, like EMK, should be recognized and valued. EMK is a rich source of information for understanding people and culture, and a valuable take-off point for projects related to resource management and sustainable development.

CHARACTERIZATION OF SMALL-SCALE FISHING COMMUNITIES FOR COASTAL ZONE MANAGEMENT PLAN IN 10TH. REGION (SOUTH OF CHILE)

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In Chile□much effort has been made to develop Integrated Coastal Zone Management (ICZM). To achieve this goal, the first step is to know the current status of all sectors involved in the utilization of coastal marine resources. Small-scale fishery is one of the most important economic sectors, supplying high valued fin-fish and shellfish to both domestic and export markets. In the small-scale fishery sector, in 2001, there were 37,777 registered fishers and 9,753 registered vessels; the total amount of fish landed reached to 1,014,790 tons. In the Region 10th, small-scale fishers account for 35% of the total number of fishers in the whole country, with the second largest volume of fisheries production (18%). Although the small-scale fishery greatly contributes to the growth of local economy, demographic and socio-economic information on coastal fishing villages is still deficient. This becomes a great obstacle to any planning and decision-making process of sustainable coastal resource utilization.

The purpose of this presentation is to characterize 187 fishing villages in the Region 10th in both demographic and socio-economic aspects. This data covers 96% of all fishing villages in this region. Special attention will be paid on economic development level, social, organizations and institutionalization, and fishing business. One important aspect is the spreading of new management tools such as Management and Exploitation Areas (AME) for Benthonic Resources enacted in 1991. This is based on the concept of community-based management approach. This presentation in the last part will discuss on perspective of such decentralized and participatory coastal resource management.

DISCARDS OF BOTTOM TRAWLING ALONG KERALA COAST IN INDIA AND ITS IMPACT ON MARINE BIODIVERSITY

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Quantity of marine organisms discarded from commercial bottom trawl fishing along Kerala coast, India has been quantified during April 2000- March 2002 and presented. The quantity of discards thrown back in to the sea during 2000-01 and 2001-02 from bottom trawl nets was estimated at 262,000 and 225,000 tones respectively. The discards were grouped in to 11 taxa, comprising of 103 species of finfishes, 65 species of gastropods, 12 species of bivalves, 8 species of shrimps, 2 species of stomatopods, 12 species of crabs, 5 species of cephalopods, 3 species of echinoderms and four species of jellyfishes. The average quantity in respect of the above groups during the study period were : fin fishes - 95,000 tons, gastropods – 22,000 tons, crabs – 68,000 tons, jellyfish – 3,000 tons, cephalopods – 29,000 tons, stomatopods – 40,000 tons, juvenile shrimps – 5,000 tons, soles – 3,000 tons, eggs – 8,900 tons, Echinoderms – 1,800 tons and snakes – 1,000 tons. In both the years, finfish appeared as the dominant group among the discards. Discards were highest during September in both the years whereas it was least in November in 2000-01 and in December during 2001-02. The edible portion of the discards during 2000-01 was quantified as 87,000 tons, which accounted for 33.3% while in 2001-02 it was 80,000 tons accounting for 35.5% of the total discards. The average catch per hour of discards was 58.82 and 52.49 kg/hr during the first and second years respectively while the average catch per unit during the preceding and succeeding years were 359.25 and 307 kg/unit respectively. During the first year, the catch per unit as high as 800.7 kg was recorded in September while in the second year, the highest was 692 kg/hr in August. Species diversity of discards was highest in 21-40m depth zone with Shannon diversity indices of 3.27 and 3.37 during the first and second years respectively. A total of 95 (2000-01) and 87 (2001-02) species under the discarded category were recorded from the 21-40 m depth zone. The species diversity showed an inverse relationship with depth. The CPUE of discards was found to be more in the 41-60 m depth zone during both the years of study registering 88.37 (2000-01) and 91.21 kg/hr (2001-02). Finfishes dominated in the discards in almost all the depth zones except 41-60m-where crabs were found as the dominant group.

The epifauna thrown back into the sea from the bottom trawlers during 2000-01 and 2001-02 were computed at 168,000 and131,000 tons respectively. The epifaunal discards comprised of 13 species of finfishes, 23 species of gastropods, 14 species of crabs, 4 species of shrimps, 2 species of stomatopods and 3 species of echinoderms. Highest quantity of epifaunal discards during the period was observed during January (27,072 tons) and April (21,514 tons) respectively. Highest catch per hour of discards was recorded in monsoon season, 42.64 kg/h in 2000-01 and 41.37 kg/h in 2001-02. Catch per unit of discards in bottom trawlers was highest in August during both the years registering 531.09 and 543.23 kg respectively.

OBSERVATIONS ON THE DISTRIBUTION AND BIOLOGY OF *Chlorophthalmus bicornis* (FAMILY CHLOROPHTHALMIDAE) BEYOND 250M DEPTH ALONG THE SOUTH WEST COAST OF INDIAN EEZ.

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The distribution and biology of *Chlorophthalmus bicornis* (Famiily Chlorophthalmidae) was studied based on the specimens collected from 5 trawling cruises of FORV Sagar Sampada during the period 1999-2001 covering a large expanse of area between lat 7° N to 20° N. Length–weight relationship of the species can be expressed as $W= 2.795\ L^{2.895}$. The species was found as carnivorous, chiefly feeding on crustaceans and squids. Spawning was continuous as manifested by the presence of mature fishes in all trawling operations. Being a multiple spawner, truly spent specimens were scarcely found and faced difficulty in identification. The ovaries were found to be in the stages III to IV. The preponderance of males was discernible in most of the shoals observed.

EFFECTS OF FISH GATHERING FROM OCTAGONAL DOME ARTIFICIAL REEFS IN TONGYEONG MARINE RANCHING AREA, KOREA

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Four types of octagonal dome artificial reefs (Fig. 1) were designed and placed for enhancement of fish stocks. Seasonal changes in abundance of fish were observed by monitoring experimental reefs located in Tongyeong marine ranching area from January 2003 to April 2004. Using SCUBA we observed 18 species on small reefs, 16 on medium reefs, 11 on large reefs and 17 on the "remodel" type of reef. More species were observed in summer (5-12 spp.) than during winter (5-8 spp.). *Sebastes inermis*, *S. schlegeli* and *Neoditrema ransonneti* were associated with the reefs all year round; however, other species such as *Pagrus major*, *Halichoeres poecilopterus*, *Chromis notatus* and *Thamnaconus modestus* were temporary residents. *Sebastes inermis* occurred at the greatest density, occurring at 5 ind. $/m^3$ on medium reefs, 3 ind. $/m^3$ on the remodel reef, and 1 ind. $/m^3$ on small and large reefs, respectively. The behavior of both *S. inermis* and *S. schlegeli* showed that they could use the four types of octagonal semi-spherical artificial reefs successfully.

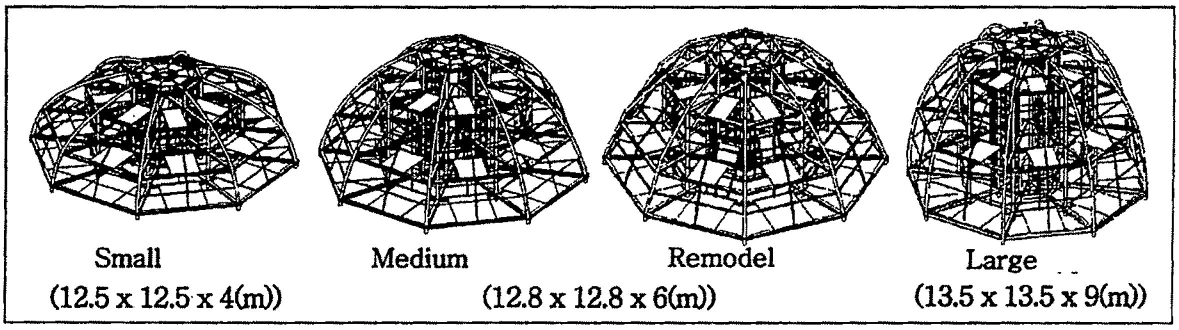

Fig. 1 The four types of octagonal dome artificial reef.

SEASONAL ABUNDANCE OF REEF FISHES IN RELATION TO LIVE CORAL COVERAGE IN PULAU KARAH, TERENGGANU, MALAYSIA

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Coral reef fish communities of Pulau Karah were studied to find their relationship with monsoon season and coral coverage. Surveys were conducted 4 times; 2 times during non-monsoon phase (May – June) and two times during monsoon phase (September-October). Visual census technique with SCUBA aid was implemented to identify the reef fishes. Line Intercept Transect method was used for the observation of coral communities. Two transect lines were laid parallel to the shoreline at 10 meters and 15 meters depth respectively to identify reef fish abundance and coral coverage. A total of 47 species belonging to 21 families of reef fishes were identified. Number of individuals in the pre-monsoon season was found to be slightly higher (64.15%) than the monsoon season (35.85). Pomacentridae was the most abundant in terms of numbers for both pre-monsoon and monsoon seasons (57.44% & 92.62%). Caesionidae was the second most abundant family in pre-monsoon (30.24%) while Lutjanidae in monsoon phase. The 10 meters transect (Transect 1) was covered with 49.54% of living corals while the other transect (Transect 2) was covered with only 18.00% of living corals. The results showed that fishes were more attracted to the area with higher percentage of live coral cover. The abundance of fishes in Transect 1 was 7238 (71.11%) while only 2941 individuals (28.89%) were observed in transect 2. Overall, there were more live corals at Transect 1 with 49.54% as compared to transect 2 with only 18.00%. This comparison showed that fish abundance was found to be higher in live coral areas than the area covered with other substrates like sand, rocks or rubbles.

FISH DISTRIBUTION IN RELATION TO BREEDING GROUNDS IN COASTAL WATERS OF TERENGGANU, SOUTH CHINA SEA

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This study involved the use of the Biosonics DT6000 to map the fish distribution and assist in surveys carried out in the waters of Pulau Karah, Terengganu, Malaysia between the months of March and April of 2004. Data logging commenced at the first assigned transect, which was placed 15 meters from the coast of Pulau Karah at coordinates 05^0 36.01' N and 103^0 03.89' E with each following transect every 1 nautical mile (1.852km) away from the coast. The acoustic survey track consisted of twelve transects which cover the entire surrounding areas of the island. The surveys were conducted 3 times a day on research vessel UNI3. The first of the 3 daily sampling sessions was in early mornings between 0800 and 1000 hours, followed by the second session at noon between 1200 and 1400 hours, and then the final session in late afternoon between 1600 and 1800 hours. The breeding ground (coral areas) was selected as one of the stations by referring to the echo sounder, which was capable of detecting large populations of fish. Results show that there exists a significant relationship between fish distribution and the selected breeding grounds.

COMPOSITION OF FOOD ITEMS OF FISH IN COASTAL WATERS OF TERENGGANU, SOUTH CHINA SEA

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The composition of food items of coral reef fish in breeding grounds of the coastal waters of Pulau Karah, Malaysia was studied. Fish samples were manually caught using fish traps by divers, and were separated and grouped into their respective families according to their species. Among the types of fish families found were Serranidae, Lutjanidae, Lethridae, Haemulidae, Chaetodontidae, Acanthuridae, Caesionidae, Carangidae, Scombridae, Labridae, Pomacentridae, Scaridae, Mullidae, Siganidae and Pomacanthidae families. All of the fish caught were gutted, their stomachs preserved and taken to the laboratory for analysis of the stomach contents. Crustaceans were found to be the main source of food for these fishes. The fish breeding grounds (coral reef areas) appeared to be most productive for studies relating to fish species, zooplankton and food sources. The results show that there exists a significant relationship between the food source of fish and zooplankton distribution in the water. Information on the availability and distribution of food items is important in the successful management of fishery resources, as well as being vital for the efficient and controlled exploitation of the fish species.

HEAVY METAL CONCENTRATIONS IN WATER, SEDIMENT AND SHRIMP FROM GROW-OUT FARMS IN JOHORE, MALAYSIA

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A study was carried out to identify the heavy metal contamination in the aquatic environment and the effects of concentrations on cultured shrimp *Penaeus monodon.* Six sampling locations in Johore were chosen that is Minyak Beku, Parit Balak, Sungai Danga, Pasir Putih, Tanjung Buai and Tenglu Laut. Sampling was carried out monthly for a period of four months. Heavy metal concentrations in water (estuaries and ponds), sediment and shrimp were determined using atomic absorption spectrophotometer.

The concentrations of Cd, Cu, Pb and Zn in water from the estuaries ranged from 0.02–05, 0.02-0.09, 0.04–0.15 and 0.06-0.38 mg/L respectively whilst in ponds ranged from 0.02-0.06, 0.03-0.10, 0.06-0.17 and 0.13-0.36 mg/L respectively. These concentrations were within the acceptable range recommended for shrimp culture. All the heavy metal concentrations showed significant differences between locations. The concentration ranges of Cd, Cu, Pb and Zn in sediment samples were 0.28-1.14, 0.68-3.53, 12.37-21.47 and 13.11-24.32 µg/g dry weights respectively. The heavy metal concentrations were generally within the ranges reported by previous researchers for shrimp pond sediment. Significant differences among locations were found only for Pb and Zn. Concentrations of Cd, Cu, Pb and Zn in shrimp ranged from 0.02-1.21, 8.21-49.45, 0.09-2.91 and 21.43-91.41 ug/g dry weight respectively. The results showed that shrimp cultured in ponds accumulated all the metals studied. In general, the level of heavy metal concentrations in shrimp did not exceed the maximum permissible limit. Except for Pb, analysis of variance showed that concentrations of Cd, Cu and Zn in shrimp varied significantly among locations.

Correlation analysis showed significant relationships between Cd concentrations in shrimp and in pond water and sediment. For Pb, significant correlation between the metal concentrations in shrimp and sediment were obtained. There was no correlation between the Cu and Zn concentrations in shrimp and pond water or sediment. The results showed that Cd and Pb concentrations in the environment (water and sediment) directly influenced their concentrations in shrimp but not for Cu and Zn.

TEMPORAL PARTITIONING BY *Hampala macrolepidota* IN THE LOTIC HABITAT OF KENYIR RESERVOIR

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Kenyir reservoir appears to harbour a variety of fish populations. *Hampala macrolepidota* (locally known as sebarau) is one of the potential sport fishes in this reservoir. For the management of fisheries resources, the knowledge of ecological segregation, especially food and habitat of fishes is very important. This is because the food consumption of most fishes under natural condition changes with time of the day, season of the year, size and age of the fish. The difference in the timing of reproduction was the major means of seasonal separation. Such differences may reflect separation of the food and/or habitat factors.

Individual size and the diel period were the main factors responsible for diet variation and food partitioning that evolved according to cyclic (temporal) trends. Diel patterns of activity showed that *Hampala macrolepidota* was not a continuous feeder. It was observed that the peak feeding time for small sized fish (0-10 cm) was at mid-morning to noon (1000-1200 hours), for medium (11-20 cm) and for large fishes (> 21 cm) was at night 2000-2200 hours and 2200-2400 hours, respectively. Feeding activity also changed with the different seasons as it was comparatively higher during the dry season (non monsoon) than that of wet (monsoon) period. Thus, the feeding activity of different sized fishes at different times would suggest that temporal differences could have a significant effect in partitioning of food resources. Nevertheless temporal partitioning seemed as important as food partitioning in structuring the different sizes of *H. macrolepidota* in the lotic habitat of Kenyir reservoir.

Table 1 Diel pattern of feeding activity for different sizes of *Hampala macrolepidota*

cm/hours	2400-0400	0400-0800	0800-1000	1000-1200	1200-1400	1400-1800	1800-2000	2000-2200	2200-2400
0-10	PF	PF	MF	AF	MF	PF	MF	MF	PF
11-20	MF	PF	MF	PF	PF	PF	MF	AF	MF
21-30	MF	MF	PF	PF	PF	PF	MF	MF	AF

Note:

PF ~	**MF ~**	**AF ~**
Poorly fed	Moderately Fed	Actively Fed

STATUS OF FISHERIES RESOURCE AND MANAGEMENT APPROACH IN THREE OPEN BEELS IN BANGLADESH

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Community Based Fisheries Management Project started fish catch monitoring program in 1997 coveing Ashura beel, Goakhola-Hatiara floodplain and Dikshi beel in Bangladesh. Analysis revealed that thenumber of subsistence fishers increased and a quite number of full time fishers mostly depend on beel fishery. Maximum diversity of fish species was in Ashura, followed by Dikshi and Goakhola-Hatiara. Highest catch rate was in Ashura and Dikshi for seine net and in Goakhola-Hatiara for lift net. *Puntius sophore*, small prawn, *Mystus tengara*, *Wallago attu*, *M. pancalus*, *Chanda sp* and *S. bacaila* contributed 82.6% of the overall production in the Ashura beel. In Goakhola-Hatiara beel, *P. sophore*, *Channa punctatus*, *Anabas testudineus*, *M. pancalus* and *C. striatus* contributed 65.46% of the overall catch. While in Dikshi beel, small prawn, *C. punctatus*, *P. sophore*, Kholisha and *M. pancalus* contributed 68.0% of the overall catch. Fishing gear operated in the three beels harvested most of the main species within or between gears. Estimated MSY for Ashura, Goakhola-Hatiara and Dikshi beels suggested 48.0, 23.0 and 78.0 tons, and corresponding fishing effort to be 16452, 7812 and 19984 gear day's year^{-1} respectively. Analysis of effort data indicated a high increase in the number of gears used since catch monitoring started. Maximum fishing pressure has been reached for all three floodplains beels and further increase in the number of gears should be stopped.

FISH COMMUNITY OF TWO RURAL LAKES AND SOCIO-ECONOMIC ASSESSMENT IN BUMBUNG LIMA, KEPALA BATAS

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A preliminary study on the fish community in two rural lakes in Bumbung Lima, Kepala Batas was conducted from May 2003 to November 2003. Species abundance and composition were affected by various factors such as water quality, encroaching of aquatic vegetation and human activities at the study sites. A total of 28 fish species from 10 families were recorded during the study period. Cyprinidae was the dominant family while *Puntius schwanenfeldii* and *P. gonionotus* were the most widespread species identified. Socio-economic studies which include human activities in Bumbung Lima area were reviewed. Field survey using questionnaires have been carried out in an attempt to obtain information on socio-demographic status of the study sites. Results showed that over one-third of the heads of households in Bumbung Lima depended on agriculture for their living which was 36.25% followed by 27.5% were government servants. In terms of education, majority of respondents received their level of education only until secondary school, which was accounted for 50% of overall education. Regarding monthly income, about one-third of the respondent earned below than RM 400 per month (33.75%). Only 18.75% of the respondents obtained a salary above RM 1000 per month, which was comparatively small and thus form only a minor portion of total respondents.

DETERMINATION OF STOCK / UNIT POPULATION OF INDIAN MACKEREL *Rastrelliger kanagurta* THROUGH MORPHOLOGICAL CHARACTERISTICS IN THE SOUTH CHINA SEA OF MALAYSIAN WATERS

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Indian Mackerel (*Rastrelliger kanagurta*) is one of the major pelagic fishes in the South China Sea waters. This fish is highly migratory and has been recognized as a shared stock among the countries surrounding the South China Sea. The objective of this study is to determine the stock / unit population of *R. kanagurta* based on morphological variation through statistical analysis. Sampling for twenty morphological characteristics of *R.r kanagurta* was conducted in August 2003 at three landing sites namely Kuantan (Pahang), Kota Kinabalu (Sabah) and Kuching (Sarawak). One hundred individuals were measured for morphological characteristics at each sampling site. The standardized morphometrics data were analyzed through univariate analysis of variance (ANOVA) and multivariate analysis of variance (MANOVA) using the MINITAB statistical software for obtaining the canonical discriminant.

The results showed that 26 % of *R. kanagurta* that had been caught at Kota Kinabalu were predicted to be coming from Kuching waters, while 8 % from Kuantan population. Whereas 21 % of *R. kanagurta* that were caught in Kuching waters were coming from Kota Kinabalu and 6 % from Kuantan population. Five percent of the stock caught in Kuantan waters came from Kuching population and 4 % from Kota Kinabalu. The results showed that there is mixing of *R. kanagurta* stocks of Kota Kinabalu and Kuching. It is possible that this resource is shared between Kota Kinabalu and Kuching populations in the South China Sea. Kuantan waters seem to host a different population for the species.

Table 1 The results of discriminant analysis of *Rastrelliger kanagurta* from three populations.

Population		Kuantan	Kota Kinabalu	Kuching	Total
Kuantan	Number of Individual	91	3	5	100
	Percentage (%)	91	3	5	100.00
Kota Kinabalu	Number of Individual	8	66	26	100
	Percentage (%)	8	66	26	100.00
Kuching	Number of Individual	6	21	73	100
	Percentage (%)	6	21	73	100.00
Error Classification					0.231

POPULATION BIOLOGY OF THE MARBLED OCTOPUS *Octopus dollfusi* ROBSON, 1928 CAUGHT BY TRAWL FISHERIES IN PRACHUAP KHIRI KHAN PROVINCE

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Population biology of the marble octopus *Octopus dollfusi* in Prachuap Khiri Khan Province was studied. Samples were collected during January – December 2002 from pair trawlers landed at Hua Hin Fishing Port.

The estimated sex ratio (female to male) was significantly different from 1:1 ($p<0.05$). Sex ratio categorized by length class was low at 62.5 mm and high at 92.5 mm. The relationship between mantle length (L) and weight (W) for male, female and combined sex were $W = 0.001 * L^{2.6028}$, $W = 0.0018 * L^{2.4546}$ and $W = 0.0014 * L^{2.5182}$ respectively.

Ratio of reproductive female to total female categorized by length class could be described by a logistic curve: $P_L = \frac{1}{1+e^{13.131-0.233*L}}$. Calculated average length at first maturation was 65.35 mm. The marble octopus spawns all year round, with two peaks: March to May and August to October. The relationship between fecundity (F_c) and mantle length (L) could be described as $F_c = 2.2586 * L^{1.8482}$

The estimated asymptotic lengths (L_∞) in male and female were 103.56 and 115.42 mm while curvature parameters (K) were 1.145 yr^{-1} and 1.6 yr^{-1} respectively. The total mortality coefficients (Z) were 3.3042 yr^{-1} in male and 4.6482 yr^{-1} in female. The natural mortality coefficients (M) were 1.1632 yr^{-1} and 1.6358 yr^{-1}, whereas fishing mortality coefficients (F) were 2.1410 yr^{-1} and 3.0124 yr^{-1} in male and female. Exploitation rate were 0.6479 yr^{-1} in male and 0.6481 yr^{-1} in female. Both male and female octopuses were heavily exploitation.

IMPACT OF FISHING PRACTICES ON THE EXPLOITATION OF FLOODPLAIN FISHERIES RESOURCES IN BRAHMANBARIA, BANGLADESH

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Floodplain fishery plays an important role in the economy of Bangladesh and the livelihoods of the people living adjacent to those floodplains. There has been indication of declining fish stocks which needs closer examination. Consequently, a survey was conducted in the Titas floodplain (Nabinagor-Bkdhor-Urkhulia) to identify the gears, catch per unit effort (CPUE), catch composition, species diversity and production during monsoon, from July to November 2001 (flooding period). A total of 35 different types of gears of seven categories were identified. The total monthly average number of different gears operated varied from 493 (seine net) to 40 (push net). Fishing effort of seine net, gill net and set bag nets were 0.0205, 0.0229 and 0.0028 gears/ha/day, respectively. The set bag net had the highest CPUE (15.41 kg/ha/day) followed by seine net (6.71 kg/ha/day) and gill net (4.81 kg/ha/day). Average CPUE of combined gears was 4.93 kg/gear/day and the estimated production of the floodplain were 44 kg/ha/year. In combined catch, more than 26% fish were *Cypriniformes* (carps) including *Puntius sophore, P. sarana, Labeo rohita* and *Cirrhinus mrigala*, 15% were catfish (*Wallogo attu, Mystus aor, M cavasius*, etc.), 13% were pearch and the rest 54% was small and medium size fish and prawns. The yields indicated that the floodplain is not as severely exploited as previously believed. However, there is a need to formulate sustainable management strategy to conserve the resource before it reaches critically low level.

Table 1 Fishing effort (gears/ha/day) and catch per unit effort (gears/ha/day) and total catch of the different categories of gears at the Titas floodplain.

Gear type	Gears operated /month	Fishing effort (gears/ha/day)	CPUE) (kg/gear/day)	Total catch (kg)
Gill net	480	.0205	4.81	1147
Seine net	493	0.0229	6.71	16522
Set bag net	61	0.0028	15.41	1879
Cast net	92	0.0042	1.21	219
Push net	40	0.0018	0.55	105
Traps	82	0.0035	1.45	369
Hooks & lines	56	0.0025	4.38	580

RELATION OF HABITAT PARAMETERS WITH ABUNDANCE OF FOUR CRITICALLY ENDANGERED AND ENDEMIC FISHES-DEVELOPMENT OF HABITAT SUITABILITY INDEX MODELS

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The relation of habitat variables with abundance of four critically endangered and endemic fish species of Kerala, India viz. *Silurus wynadensis* and *Neolissocheilus wynadensis* which are endemic to upstream reaches of Kabbini , *Puntius chalakudensis*, endemic to the upper reaches of Chalakudy and *Osteocheilus longidorsalis* whose distribution is highly restricted to hill zones of Chalakudy and Pooyamkutty rivers were established. The presence of these species were found significantly correlated with some of the habitat parameters and therefore those parameters showing the highest degree of correlation with the biomass of the above species were used for deriving the habitat suitability index (HSI) models. Of the 54 physico-chemical parameters collected from the 14 locations, 7 parameters viz. atmospheric temperature, channel width, flow velocity, overhanging stream boulders, total cover, trench pool and water temperature showed very high degree of correlation with the availability of *S. wynadensis* and the formula showing the HSI was Y=0.20-1.01AT-0.11CW-0.11CW-0.05FV+0.33OSB+0.05TC+0.13TP+1.29WT. On the contrary, *N. wyndaensis* showed a highly significant correlation with alkalinity, channel width, hardness, lateral pool, overhanging stream boulders and plunge pools in the locations from where the species was recorded which was explained as Y=7.62-0.38A-0.007CW-0.5H+0.1LP-0.3OSB-7.7PL. However the abandoned channel, bedrock substratum, emergent vegetation, glide, overhanging stream boulders showed a direct bearing on the presence of *O. longidorsalis* while the relationship was inverse with channel width which can be extrapolated as Y=0.104+0.149ABC+4.82BW+0.179EV+0.123G+0.09OSB-0.09CW. Whereas in *P. chalakudensis* a direct correlation was established with abandoned channel, rocky substratum and channel width while an inverse relationship was found with cascade habitat and alkalinity which can be expressed as Y=0.38+0.34ABC-0.04C+0.03R-0.45A+0.04CW. The results revealed that the nature of microhabitats and macro habitats, type of substratum, riparian zone, types of instream cover and other physico-chemical habitat variables profoundly act as the critical parameters in deciding the highly restricted distribution shown by the four endangered fish species in Kerala river systems. The paper also revealed that the knowledge on critical habitat issues of each fish species is deficient especially in tropical regions hence it is imperative that research efforts need to be directed in this direction for defining less ambiguous habitat suitability criteria.

ON THE SUSTAINABILITY OF DEEP SEA PRAWN FISHERY OFF KERALA (SOUTH INDIA)

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The deep sea environment is generally regarded as being one of low energy and low productivity. The innovative small and medium shrimp trawlers ventured in to the deep sea prawn fishing for the first time in the history of Kerala (South India) in November 1999 defying the long held concept that deep sea prawn resources could be harvested only with the help of large trawlers. Deep sea prawns like *Heterocarpus gibbosus*, and *H.woodmasoni* have slow growth rates and high longevity compared to traditional commercial species from the coastal waters off Kerala. They have low levels of sustainable yields, are vulnerable to over fishing and have slow recovery rates. Yet, they are often high value species, and this has maintained interest in developing new fisheries for deep sea prawn species. Due to the encouraging results realized from the deep sea trawling operations during 2000-01, more and more boat owners modified their trawlers and equipped them for deep sea trawling and started venturing to greater depth zones. As a result the deep sea prawn fishery showed a drastic decline from 48,675t in 2000-01 to 19,285t in 2001-02, thus registering a reduction to the tune of 60.35% in the deep sea prawn landings. A reduction in the catch per hour to the tune of 53.57% during the 2nd year is also worth noticing. Depth wise catch/hr also showed a drastic decline during the 2nd year. Monthly variation in the catch/hr and CPU of various species were also worked out and the results showed that catch/hr of *Heterocarpus gibbosus* declined from 6.69kg in the preceding year to 5.66kg during the succeeding year while the catch/hr of *Aristeus alcocki* showed a drastic decline from 9.72kg in the 1st year to 5.39kg in the second year. Similarly in *Parapandalus spinipes* and *Metapenaeopsis andamanensis*, a decline to the tune of 3.26kg and 3.15kg each respectively were observed in the 2nd year. Percentage of berried pandalid shrimps were found to be very high in the population, in the range 71.33 to 91.25% and a decline of the fishery registered during the second year can well be attributed to the indiscriminate exploitation of berried females in the commercial landings. From the results arrived at on the growth rates of deep sea prawns based on monthly distribution of length frequency, it appeared that the growth rate is very slow when compared to their counterparts inhabiting in the coastal waters. This paper also discusses various measures relevant for the sustainable exploitation and management of deep sea prawns off Kerala.

AN OVERVIEW OF FISHERIES EDUCATION AND RESEARCH IN BANGLADESH UNIVERSITIES

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Fisheries research was started in Bangladesh in the late forties. This began in the Department of fisheries (DOF) and was followed by academic research from the Department of Zoology, University of Dhaka; Institute of Marine Sciences at Chittagong University and Department of Zoology at Rajshahi University. Higher education in the fisheries made a significant advance in 1967 with the establishment of the Faculty of Fisheries in Bangladesh Agricultural University that offers graduate and post graduate level degrees as well as modest research program. Fisheries and Marine Resources Technology Discipline at Khulna University also offers graduate level degree in the field of fisheries. Under the umbrella of Ministry of Fisheries and Livestock, the DOF and BFRI are also engaged in transfer of technology and adoptive research. Beside these, a lot of NGO's *viz.,* DFID, WorldFish Center (ICLARM), CARE, CARITAS, BRAC, Proshika, ect., is involved in fisheries education, research and sustainable resource management in Bangladesh.

	Dept or Faculty	No. of teaching staffs	Number according to Qualification			No. of teaching staffs Position wise				No. of BSc (Hons) students	Teacher: Student Ratio
			PhD	MSc	BSc	Prof	Asst Prof	Assoc Prof	Lecturer		
BAU	(4 dep.)	45	31 69%	14 31%	-	25 56%	5 11%	5 11%	10 22%	60	1:1.33
CU	IMS	15	6 40%	9 60%	-	7 47%	3 20%	-	5 33%		
DU	Zoology	13	11 85%	1 15%	-	9 69%	-	3 23%	1 80%	25	1:1.92
	Aqua. & Fish.	4	3 75%	1 25%		1 25%			3 75%	15	1:3.8
KU		19	3 19%	13 68%	3 16%	1 5%	1 5%	8 42%	9 48%	35	1:1.8
RU	Zoology	7	4 57%	3 42%	-	3 42%	-	2 28%	2 28%	15	1:2.1
	Total	103	58 56%	42 41%	3 3%	46 45%	9 9%	18 17%	30 39%	150	1:1.45

SPATIAL PATTERN IN HOUSEHOLD FISH DEMAND: THE CASE IN THE PHILIPPINES AND BANGLADESH

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Previous studies showed that fish consumption in Asian countries varies significantly with respect to fish type, prices and to different classes of the society. However, the spatial aspect of fish consumption in the region is not well documented. This paper sought to establish spatial pattern of fish consumption in the Philippines and Bangladesh using country-specific country-wide household expenditure surveys (e.g. Family Expenditure Survey or FIES 2000 for Philippines and Household Expenditure Survey or HES 2000 for Bangladesh).

A geographic information system (GIS)-generated maps on fish consumption show a spatial heterogeneity on consumption of fish in the Philippines and Bangladesh. Initial results from semivariogram indicate presence of spatial autocorrelation in fish consumption. A spatial model of fish expenditure function is estimated incorporating spatial pattern to test spatial relationships in demand for fish in these countries. A comparison is made between this spatial version of fish expenditure function and a traditional fish expenditure function. The paper concludes by providing policy implications.

SOCIO-ECONOMICS OF PRAWN CULTURE DEVELOPMENT IN BANGLADESH FOR SUSTAINABLE LIVELIHOODS OF THE RURAL POOR

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A study was carried out in Mymensingh region in Bangladesh to understand current practice of freshwater prawn *Macrobrachium rosenbergii* production and related socio-economic issues. The livelihoods of a large number of rural poor are associated with prawn production. From the survey, 94% of farmers cultured prawn with fish in their pond. The culture period is typically nine months. Hatchery produced fry are stocked in May-June and harvested from November to January. The average stocking density of post-larvae was found to be 20,415 ha^{-1}. A variety of feeds such as rice bran, oil cake, wheat flour and fishmeal are used for prawn culture. Prawn productivity is variable because of simple culture method, averaging 385 $kg.ha^{-1}$ $year^{-1}$. The freshwater prawn is a highly valued product for international markets and is therefore exported.

All farmers made a profit, with seed and feed dominating variable costs. Considerable variation in production costs (average US$ 925 $ha^{-1} \cdot year^{-1}$) and profitability (average net return US$ 1,180 $ha^{-1} \cdot year^{-1}$) was observed. The culture of prawn in pond systems is technically possible in a variety of conditions though expansion of small scale farming mainly depends on reducing production costs.

In spite of socio-economic constraints, 71% of the households of farmers have improved their status through prawn farming. However, concerns arise about the long-term sustainability of prawn farming due to flood, lack of technical knowledge of farmers, poor supply of hatchery fry, high seed and feed prices, lack of access to credit, poor institutional support and inadequate extension services; all of which have affected sustainable livelihoods of prawn farmers. It is essential to provide the necessary institutional and organizational supports and extension services for sustainable prawn production.

DISTRIBUTION OF ENDEMIC AND THREATENED AQUATIC PLANT SPECIES IN THE POLONNARUWA DISTRICT OF SRI LANKA

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Aquatic plant distribution in Sri Lanka is not well documented. Since 90% aquatic plants occurring naturally in Sri Lanka, have a good export market related to the Aquarium industry, collection of plants from the wild for commercial purposes has posed a great threat to their existence. Although it is prohibited by law to export wild collected plants or plant parts, many plants from their natural habitat still find their way to the export market. The present study was aimed at establishing the population status of commercially important endemic and threatened indigenous species in Sri Lanka, and this paper reports their status in the Polonnaruwa district.

Polonnaruwa is a dry zone district containing large number of seasonal and perrenial reservoirs, streams and irrigation canals. Agriculture is the main livelihood in the area with rice farming the largest agricultural activity.

Four species of threatened aquatic plants according to the IUCN red data list were found in the district. Two of these were endemic to Sri Lanka belonging to the family Araceae, Genus *Cryptocoryne*. The other two species belonging to families Aponogetanaceae and Araceae were distributed in other parts of South Asia.

The results showed that *Aponogeton natans* is distributed throughout the district mainly in seasonal tanks, with a density of 2-8 plants/m^2. The distribution was limited to 5m from the water edge. *Lagenandra lancifolia* was found only in 3 seasonal tanks with a density of 1-2 plants /m^2. *Cryptocoryne wenditii* was recorded from several streams and canals but not in reservoirs. Their distribution was very limited with small patches less than 0.5m^2 in area distributed in small areas of the stream. Their numbers varied between 22-60/m^2. *Cryptocoryne parva* was recorded from 4 locations in streams in the western part of the district and the population was limited to a patchy distribution with patch size of more than 0.64m^2.

Since these plants were important in the indigenous medicine, removal of these plants from their natural habitats for commercial purposes poses a great threat to their existence. Sand mining, habitat destruction, pollution from agricultural pollutants, collection of polythene and detergents and invasive aquatic weeds were found to be the other major threats to these species.

FISH DIVERSITY AND INTER-SITE RELATIONSHIP OF HEADWATER STREAMS OF TERENGGANU, PENINSULAR MALAYSIA

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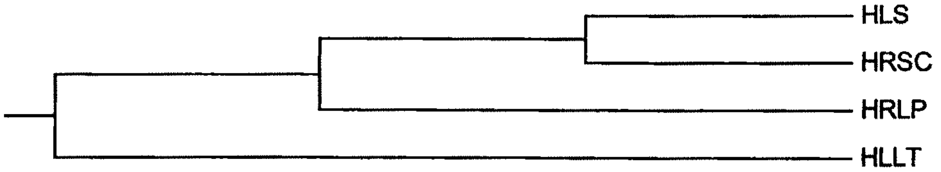
Headwater streams are characterized by fast flowing, clear and cool water.Bottom substrates comprise of sand, pebbles, boulders and rocks, and streams are under forest shades. Rapids, pools and riffles are prominent features here. Freshwater fish inhabiting headwater streams of Terengganu were surveyed between September to November 2003. The objective was to record fish diversity found in this ecosystem. The 17 families and 46 species of fish recorded from four headwater streams, *i.e.* Lata Tembakah, Besut (HLLT); Lata Payong, Setiu (HRLP); Sg. Sekayu, Kuala Berang (HLS) and a tributary of Sg. Cemerung, Dungun (HRSC) in Terengganu comprised 17 species from the family Cyprinidae (37%), followed by four species of bagrid catfish and mastecembelid fish respectively. Fourteen species are regarded as strongly upstream species, but majority is opportunist species that distributed further downstream. At least 40% of the species are highly suitable for aquaria and many more can be utilized as ornamental fish for large aquarium. Two species collected in the study namely *Rasbora bunguranensis* and *Tor tambra* are listed in the 1990 IUCN Red List of Threatened Species.

Fish species inhabiting headwater streams in Terengganu did not show longitudinal (north-south) distribution. Analysis of inter-site similarity revealed that HLS-HRSC has the highest proximity in term of species occurrence. Further studies will investigate the roles of habitat and water quality on fish diversity and distribution.

Table 1 Distribution and status of fish species from four headwater streams of Terengganu.

	HLLT	HRLP	HLS	HRSC
No of family	4	3	14	12
- no of Cyprinidae	6	10	10	7
No. of species	11	13	30	22
Upstream species	5	6	5	2
Threatened species	-	+	+	+

Figure 1 Jaccard similarity coefficients phenogram for comparing fish assemblages among four headwater streams in Terengganu.



FRESHWATER FISH DIVERSITY AND THEIR SOCIO-ECONOMIC POTENTIAL AT BATANG KERANG, BALAI RINGIN, SARAWAK, MALAYSIA

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A survey of the diversity of fish fauna in Batang Kerang, Balai Ringin, Sarawak, Malaysia was conducted from April 2003 to April 2004. A total of eight families of fish represented by 22 species were caught from the main Batang Kerang and its tributaries. The study showed that the river is inhabited by several introduced species such as *Helastoma temminckii* and *Osteochilus hasseltii.* The Batang Kerang river system supports an important fish supply that provides a major source of food and income for the local community. Besides, the river also plays an important role as a path for river transportation in the rural areas. Most of the fish catch will either be for own consumption or sold directly by the fishermen or through fishmongers at the local market. Land use development within the area, over fishing, unsustainable fishing methods and invasion of exotic species may exert a tremendous pressure on the population and diversity of fish fauna.

STATUS OF FISH GENETIC RESOURCES OF THE RIVERS OF KERALA (S. INDIA) AND AN EVALUATION OF THE FISH GERMPLASM FOR THEIR SUITABILITY FOR AQUACULTURE AND ORNAMENTAL PURPOSES

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The convention of biological diversity held in 1992 made it vary clear that the country has the sovereign right and responsibility for the conservation and sustainable use of biological diversity for meeting the food, health and other requirements of the growing populations. Of the 44 rivers of Kerala, 21 were surveyed for their fish germplasm resources. The important rivers surveyed include Bharathapuzha, Kabbini, Moovattupuzha, Chalakkudy, Periyar, Pamba, Achenkoil, Kallada, Valapatnam, Puzhakkal, Karuvannur, Tirur, Chaliyar, Manimala,Meenachil ,etc. One hundred forty three fishe species were collected from 21 river systems of Kerala, among them 62 were found suitable for as ornamental fish, while 3 were having the desirable qualities to promote as candidate species for aquaculture. Among the 62 species identified suitable for ornamental culture, 10 species such as Denison's barb *(Puntius denisonii),* Rosy barb (*Puntius conchonius*), Indian tiger barb *(Puntius fasciatus),* Ticto barb (*Puntius ticto*), zodiac loach (*Nemacheilus triangularis*), Freshwater Puffer fish (*Tetradon travancorcus*) ,Hill trouts (*Barilius bakeri and B. gatensis.),* Danios (*Danio malabaricus and D.aequipinnatus*), Yellow cat fishes (*Horabagrus brachysoma, H. nigricollaris*) have already secured positions in the export market from the state. The species which are endowed with tremendous potential for their immediate introduction as ornamentals are Killi fishes (*Aplocheilus lineatus*), Parrot fishes (*Pristolepis marginatus*), Glass fishes (*Parambasis thomassi* and *Ambassis gymnocephalus*), Fresh water eel (*Mastacembeles armatus*) and Leaf fish (*Nandus nandus*). Data base in respect of 62 species on their spatial and temporal distribution and abundance, stock size, exploitable size groups, availability of mature specimens, locations suitable for their *in situ* conservation, etc. was prepared. Forty five species were successfully domesticated under captive conditions. Observations were also made on the time taken for acclimatisation, compatibility with other species, type of food consumed, behaviour conditions in the aquarium tanks, etc. The 3 species suitable for aquaculture are *Barbodes carnaticus, Gonoproktopterus thomassi and Osteocheilus longidorsalis.* A maximum weight of 4kgs was obtained for *Barboides carnaticus.* Specimens weighing up to 600 g were collected for *Osteochilichthys logidorsalis.* A well-relished fish by the local people and the *current market price* is around Rs.60/kg. Specimens of 4 kgs were obtained for *Gonoproktopterus thomassi*, one of the main fisheries of Kallada dam of Kallada river system. The market price of the species is between Rs. 50-60/kg.

HABITAT UTILIZATION FOR JUVENILE AND YOUNG SNAPPERS (LUTJANIDAE: PISCES) IN THE MATANG MANGROVE ESTUARY, WEST COAST OF PENINSULAR MALAYSIA

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The study was undertaken to investigate the habitat utilization of juvenile and young lutjanid fish in the Matang mangrove estuary, west coast of Peninsular Malaysia by examining their distribution pattern and feeding habits. Eighteen sites were sampled using otter trawl nets from October 10 to 12, 2003 and 21 sites were sampled using fish traps from October 28 to 31, 2003. All lutjanid fish collected were sorted, and fixed in 10% formalin solution. In the laboratory, total length (TL) was measured, stomach contents were identified and the gonads were staged for maturity.

In total 94 individuals of juvenile and young lutjanid fish (87 *Lutjanus johnii*, six *L. russelli* and one *L. argentimaculatus*) were caught by trawl nets at 12 of the 18 sites. In contrast, only seven *L. johnii* were caught by fish trap at four of the 21 sampling sites. The size of lutjanid fish varied among species. The most abundant species, *L. johnii*, included the smallest individuals and ranged in size from 2.8-21.9cm. The size range of *L. russelli* was small (11.5-14.3cm) and the single *L. argentimaculatus* captured was 21.8cm. All lutjanid fish caught were immature. Compared to the previous study, a smaller boat was used in this stuffy and towed more in shallow waters near the river shore and collected more *L. johnii*. Thus, the density of juvenile and young *L. johnii* is higher in shallow waters near the river shore compared to the deeper water near the center of the stream. *L. johnii* dominated the lutjanid species in both number and the range of distribution area. The smallest individuals of *L. johnii* (< 5cm TL) occurred in the coastal area and river mouth. The next size class (5-15cm TL) occurred in the mouth to the lower reaches of the river, while fish over 15cm TL were widely distributed occurring from the most upper reaches to the coastal area. The diet of *L. johnii* varied ontogenetically. Small *L. johnii* (< 5cm TL) fed on Copepoda and Mysidacea larvae, fish 5-10cm TL fed on Mysidacea, fish 10-15cm TL fed on Natantia, Mysidacea and Brachyura, whereas fish over 15cm TL fed mainly on *Brachyura russelli* (11.5-14.3cm TL) fed mostly on Mysidacea.

IMAGE ANALYSIS OF TYPHOON IMPACTS ON SOFT CORAL COMMUNITY AT SOUTHERN JEJU, KOREA

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Impacts of Typhoon Maemi on a soft-coral community located on subtidal cliff at Munseom, Jeju, Korea were investigated in this study using underwater photography. To estimate numbers and size of soft-coral colonies, a line transect was installed on the cliff at depth from 3 to 9 m and photographs were taken serially by every 1 m. From each 1×1 m underwater photograph, species and size of soft-coral colony was determined. Number of soft-coral colonies and its percent coverage (PC) in each 1 m^2 quadrat was calculated. Soft corals *Scleronephthya gracillimum*, *Dendronephthya gigantea*, *D. putteri*, *D. spinulosa* and *D. castanea* were identified from the photographs *Dendronephthya* sp. was mainly distributed at 3-6 m depth while *S. gracillimum* mostly occurred at 6-9 m depth. Typhoon Maemi hit Jeju Island in late September 2003 and its impact was strong enough to destruct most shallow water sessile benthos including soft corals. A survey conducted before the typhoon showed that number of the soft-coral colonies at 3-4 m, 4-5 m, 5-6 m, 6-7 m, 7-8 m and 8-9 m was 17, 24, 20, 23, 18 and 30 colonies/m^2 or 21, 48, 36, 28, 24 and 43%, respectively. After the typhoon, number of soft-coral colonies in the transect increased to 31, 35, 27, 10, 21 and 50 colonies/m^2 while PC remarkably decreased to 21, 23, 21, 5, 9 and 13%, respectively. Our data suggested that the impact was limited in larger colonies; larger soft coral colonies were selectively destroyed and removed while the small colonies underneath the larger colonies remained undestroyed.

EFFECT OF TANNERY EFFLUENT ON THE NONSPECIFIC IMMUNE RESPONSES IN TILAPIA *Oreochromis mossambicus*

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The heavy load of various industrial pollutants in the freshwater aquatic systems poses a serious threat to the immune system and so to the health of wild and the cultured fish. Leather tanning industries are one of the major polluters of freshwater bodies of many developing countries including India. About 1900 chrome tanning industries are in India out of which 40% are in Tamilnadu.The objective of the study was to investigate the effect of sublethal concentrations of tannery effluent on the nonspecific immune responses in tilapia, *Oreochromis mossambicus.* The effluent from the tannery was collected directly from a chrome-tanning factory situated in Dindigul district, Tamilnadu. Apart from chromium (96 ppm) the effluent contained appreciable amounts of calcium carbonate and sodium sulphate. Groups of fish were exposed to 0.1%, 1% or 10% LC_{50} of tannery effluent for two different periods, i.e., a) short term of 4days and b) long term of 28days.The nonspecific immune response in terms of serum lysozyme level, reactive oxygen species (ROS) production and reactive nitrogen intermediates (RNI) production by peripheral blood leucocytes were assayed. The study clearly indicates that exposure of fish to 10% LC_{50} of tannery effluent for 4 or 28 days decreased non-specific immune responses significantly. The long-term exposure showed a significant suppression of non-specific immune responses even at the lower concentration of 1% LC_{50}. The results will be discussed in the context of Indian freshwater finfish extensive aquaculture.

Table 1 Table showing the effect of a) short term and b) long term exposure to tannery effluent on the nonspecific immune responses of *Oreochromis mossambicus*

a)

Concentrations tested	Serum lysozyme Day 2	ROS production Day 2	RNI production Day 6
Control	642.6 ± 8.69	0.669 ± 0.015	63.8 ±1.71
0.1% LC_{50}	565.2 ±16.04	0.730 ± 0.014	55.6 ±1.90
1% LC_{50}	624.2 ± 7.88	0.636 ± 0.020	58.8 ±1.16
10% LC_{50}	631.8 ± 7.72***	0.677 ± 0.017**	61.4 ±2.02**

b)

Concentrations tested	Serum lysozyme Day 36	ROS production Day 36	RNI production Day 36
Control	651.4 ± 11.31	0.672 ± 0.013	68.4 ± 2.462
0.1% LC_{50}	547.6 ± 12.43	0.531 ± 0.013	53.4 ± 2.159
1% LC_{50}	593.0 ± 17.82**	0.591 ±0.017***	60.6 ± 2.088*
10% LC_{50}	665.0 ± 10.90***	0.653 ± 0.016***	68.0 ±1.871***

* $P<0.05$, ** $P<0.02$, *** $P<0.01$ when compared with control

EFFECT OF DIAZINON ON DIFFERENT LIFE STAGES OF ROTIFER *Brachionus plicatilis*

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The effects of an organophosphate pesticide diazinon on life history parameters and hatchability of resting eggs of rotifer *Brachionus plicalitis* were assessed. Ten newly hatched (<1 hr-old) neonates were individually cultured in five varying concentrations (0.1, 1.0, 2.5, 5.0 and 10.0 mg/l) of diazinon, and the time (hours) the rotifers bear first egg and release first neonate were evaluated. Other life history parameters in asexual reproduction such as reproductive period, net reproductive rate, intrinsic rate of population increase and life span were also recorded, and these were compared to the unexposed animals (control). Results showed that among the life history parameters, the time the rotifers took to release neonates is the most sensitive, giving the lowest EC_{50} value.

The rotifers were further reared until they produced mictic daughters. The number of amictic daughters and males of successive generations continuously exposed to pesticide was also investigated. Results showed that rotifers exposed to 10.0 mg/l pesticide produced significantly fewer amictic daughters and at this concentration rotifers did not produce any mictic daughter. At 5.0 mg/l, the number of male offspring was significantly lower than the control and lower concentrations. Furthermore, the hatchability of the resting eggs produced by the rotifers was also investigated. Rotifers were either exposed to diazinon starting from birth until they produced resting eggs (early development), or during late developmental stage of resting eggs (before diapause), as well as during diapausing stage. Rotifers exposed to two highest concentrations (5.0 and 10.0 mg/l) starting from birth did not produce resting eggs, and at 1.0 and 2.5 mg/l, the hatchability of resting eggs was significantly reduced (Table 1). However, the hatchability of the resting eggs was not affected when exposed during late developmental and diapausing stages.

The results of this experiment suggest that during the asexual phase, generation time is the most sensitive parameter in detecting effects of organophosphate pesticides in rotifer, and that resting eggs should be produced at optimal condition to obtain highest fitness to environmental stress.

Table 1 Percentage of hatched resting eggs when rotifers were exposed to different concentration (mg/l) of diazinon during early, late, and diapausing stage of resting eggs. Data are means and standard deviation of two replicates.
*Significantly different from the control (P<0.05).

Treatment	Early development	Late development	Diapause stage
Control	59 ± 13	72 ± 8	69 ± 4
0.1	37 ± 10	74 ± 6	74 ± 4
1.0	12 ± 9*	69 ± 4	63 ± 10
2.5	7 ± 4*	70 ± 2	71 ± 4
5.0	_	69 ± 3	76 ± 12
10.0	_	67 ± 4	68 ± 21

- no fertilized resting eggs were spawned

DISTRIBUTION AND CHEMICAL COMPOSITION OF TAR BALLS ALONG TERENGGANU BEACH, MALAYSIA

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Oil is being exploited along Terengganu State coast in Malaysia resulting vulnerability of these coastal waters to oil pollution. Tar balls are formed from oil spill residue on sea after a series of weathering processes occurring in the sea. Tar balls are frequently used as an oil spill indicator in the sea. Invasion by tar balls is a major pollution problem, which threatens the fishing, aquaculture, breeding of amphibious organisms and ecotourism.This study reports the distribution and chemical composition of tar balls collected along the beach of Kuala Terengganu from March 2002 to January 2004. The stranded tar balls on the Batu Rakit beach, KUSTEM beach and Teluk Ketapang Beach ranged from 3.858 g.m^{-1} to 518.006 g.m^{-1}, 0.036 g.m^{-1} to 88.347 g.m^{-1} and 0.828 g.m^{-1} to 33.465 g.m^{-1} respectively. The results indicated that monsoon season has a great influence on the tar ball distribution on the Kuala Terengganu beach. A significant higher intensity of tar balls was found on the beach during the Northeast monsoon season. The intensity of tar balls on the beach throughout the study period was higher than the pollution index of 10 g.m^{-1} (gram per meter) set by UNEP. Most of the tar balls are fresh and soft. Significant amounts of carcinogenic hydrocarbons are detected in the tar balls. Further research is required to trace the source of tar balls in the South China Sea.

BIOACCUMULATION AND DEPURATION OF PYRENE IN OYSTER *Crassostrea iredalei*

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This study is aimed to evaluate the bioaccumulation factor (BAF), uptake rate (k_u) and depuration rate (k_e) of pyrene on the oyster *Crassostrea iredalei*, exposed to 3 different exposure concentrations (50 ppb, 150 ppb and 250 ppb). The exposure resulted in BAF = 3351 (k_u=514.379 day^{-1}; k_e=0.1535 day^{-1}), BAF = 12040 (k_u=1756.636 day^{-1}; k_e=0.1459 day^{-1}) and BAF = 17190 (k_u=2504.583 day^{-1}; k_e=0.1457 day^{-1}) respectively. The results revealed that the values of BAF, k_u and k_e for 150 ppb and 250 ppb exposure are close to each other compared to the 50 ppb exposure. The depuration rate obtained can be used to estimate the time for elimination of the pyrene residue from oyster tissue under depuration condition. According to shellfish advisory level for PAHs from Carlifornia Department of Health Service is set below 5 ppb benzo(a)pyrene equivalent (BaPE). The level of pyrene detected in oyster exposed to 50 ppb was only 1.702 ppb BaPE. It is lower than the level advised and it is considered safe. Meanwhile, the time for pyrene residue elimination from oyster tissue to advisory level is estimated not more than 10 days as the initial content of pyrene in oyster tissue are 9.116 ppb BaPE and 13.911 ppb BaPE for the 150 ppb and 250 ppb exposure concentrations respectively. The depuration rate obtained from this study can be implemented in those shellfish industries that experience oil spill or oil contamination..

CHANGES IN HAEMOLYMPH NITRATE AND PROTEIN CONCENTRATIONS IN DIFFERENT SIZES AND GENDERS OF BLACK TIGER PRAWN *Penaeus monodon*

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Concentrations of nitrate and protein in haemolymph of the black tiger prawn (*Penaeus monodon*) were investigated. Shrimp collected from earthen ponds at Nakhonchai Farm in Trad Province were transferred to Bangkok and acclimated to laboratory conditions (20 ppt, 29±1°C, 6 mg/l average DO, pH 7-8 and 25 lux of average light intensity). These were used in two experiments, one focused on size and one on gender. Individual shrimp were retained in glass containers with 2 litres of 20 ppt seawater. Haemolymph samples were collected after 1 and 6 hr. Then, nitrate and protein concentrations were measured spectrophotometrically at 220, 275 and 280 nm, respectively. With shrimp of 2 different sizes (average weight 11.83±0.45 g and 20.83±1.24 g), average haemolymph nitrate concentrations for the small shrimp at 1 and 6 hr were 225.62±11.57 mM and 171.56±13.32 mM, respectively, while those for the larger shrimp were 203.64±14.68 mM, 156.79±12.98 mM, respectively. Average protein concentrations for the small shrimp at 1 and 6 hr were 121.32±10.34 mg/ml and 84.41±7.57 mg/ml, respectively, while those for the larger shrimp were 102.41±9.24 mg/ml and 74.96±6.54 mg/ml, respectively. There were no statistically significant differences ($p>0.05$, df=9) between haemolymph nitrate and protein concentrations between the size groups at 1 and 6 hr. In contrast, the level of both nitrate and protein decreased significantly ($p<0.05$, df=9) with time in both size groups. With male and female shrimp (average weights 19.03±3.50 g and 21.10±1.51 g, respectively), average haemolymph nitrate concentrations for males at 1 and 6 hr were 89.32±21.31 mM and 53.92±17.96 mM, respectively, while those for females were 66.82±18.41 mM, 58.63±13.64 mM, respectively. Average protein concentrations for males at 1 and 6 hr were 62.24±12.27 mg/ml and 47.20±9.48 mg/ml, respectively, while those for females were 52.72±9.75 mg/ml and 48.32±7.43 mg/ml, respectively. As with the size groups, there were no statistically significant differences ($p>0.05$, df=8) between the concentrations of haemolymph nitrate and protein for the two genders at 1 and 6 hr. However, the level of nitrate and protein in haemolymph of the male shrimp decreased significantly ($p<0.05$, df=9) from 1 to 6 hr and this was opposite to what happened with nitrate and protein in haemolymph of the female shrimp.

PURIFICATION AND PARTIAL CHARACTERIZATION OF SERUM IMMUNOGLOBULIN IN CASPIAN KUTUM *Rutilus frisii kutum*

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Serum immunoglobulin of Caspian Kutum (*Rutilus frisii kutum*) was purified by a combination of salt precipitation, ion-exchange chromatography and gel filtration methods. Also molecular weight and electrophoretic characters of partial serum and probable polymeric immunoglobulin types was studied on male and female fish in relation to seasonal changes in reproduction. In this respect, after serum precipitation by ammonium sulfate/or PEG 6000, and dialysis, precipitated samples was transferred to ion-exchange chromatography and gel filtration columns respectively.

In gel filtrated immunoglobulin, two distinct peaks were obtained of which the first one contained <95% purified IgM. The purity and molecular weight of the immunoglobulin preparations was determined by gel electrophoresis (SDS-PAGE) in reducing and non-reducing conditions.

The heavy and light chains of IgM were about 74-75 KDa and 25-27 KDa respectively and whole IgM molecular weight was determined as about 800 KDa. Therefore in this species as in other cyprinidae, IgM has a exclusively tetrameric structure and other polymeric type had not been seen.

In the spawning season, the IgM level was estimated at about 8.9 mg/ml and 21.6 mg/ml in male and females fish respectively. Moreover, in this season the IgM levels were reduced in both sexes. This reduction was more significant in males and probably, is related to more mortality rate in this sex.

SOME ASPECTS OF THE BIOLOGY OF *Pseudapocrypte lanceolatus* DISTRIBUTED IN THE COASTAL AREAS OF THE MEKONG DELTA, VIETNAM

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Pseudapocryptes lanceolatus (Gobiidae) is an important commercial fish in Vietnam, and they are distributed in the mud flat areas of the Mekong Delta. The current study was carried out from September 2001 to August 2002 in the coastal area of the Mekong Delta, South of Vietnam.

The relationship between body weight (BW) and total length (TL) of *P. lanceolatus* can be described as $BW = 0.2468\ TL^{1.5567}$ ($R^2 = 0.9008$, $n = 508$). The ovarian development of *P. lanceolatus* is described histologically. Results showed that there were two peaks in the spawning season of this species. The diet composition was considered in terms of weight as well as in number of prey organisms. The results also indicated that the prey items of *P. lanceolatus* consisted of diatom algae (83.12%), blue-green algae (1.90%), Copepoda (0.06%), Cladocera (0.02%), and organic matter (14.9%).

FRESHWATER FISHES OF BALAI RINGIN, SARAWAK

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The freshwater fishes community of Batang Kerang, the main river in Balai Ringin, and its socio-economic importance were studied in April 2003 until April 2004. Batang Kerang plays an important role as fishing ground and also as a path for water transportation in the rural areas. Study on the fish community revealed that Batang Kerang comprises not less then 22 species from 8 families, which were caught along the river using several methods such as gillnets, cast nets and a traditional trap net called 'selambau'. The family of Cyprinidae was found to be dominant in the river system. Two species were recognized as introduced species, namely *Helostoma temminckii* (kissing gouramy) and *Osteochilus hasseltii*. The fish resource from the river was well-utilized by the local community. Surveys done showed that about all of the species in our record have its own commercial values. This resource is very important as it serves as economic incomes and also as an important protein sources to the local community in Balai Ringin, as well as to urban community. Threats possibilities to the fish fauna in the area are include overfishing, landuse within the area, unsustainable fishing methods, and invasion of introduced fishes. Therefore, it is vital to monitor and conserve the ecosystem and environmental conditions of the area.

ECOLOGICAL STUDIES ON THE SAND DOLLAR, *Astriclypeus manni* (VERRIL 1867)- FEEDING, DENSITY AND LOCOMOTION

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Sand dollar, *Astriclypeus manni* (Echinodermata: Echinoidea) is widely distributed on subtidal sand flats all along the coast of Cheju Island, Korea. Limited information was available on their ecology despite their abundance. This study reports gut contents, density and locomotion of the sand dollars distributed on a subtidal sand flat on the north-east coast of Jeju Island in Korea.

Microscopic examination of the gut contents indicated that *A. manni* feeds on inorganic and organic detritus as well as live organisms in the sediments. Inorganic particles included sand grains, sponge spicules and shells of benthic animals such as foraminifera, crustaceans and molluscs. Mean diameter of sediment particles retained in the gut was 77.6±22.2 μm. Live organisms retained in the gut included foraminifera, harpacticoid copepods, nematodes, diatoms and unidentified eggs. Spatial distribution pattern of the sand dollar was found to be random with a mean density of 0.4 individual m^{-2} (χ^2=85.16, p>0.05). Locomotion speed of the sand dollar measured *in situ* was 2.0 to 65.0 cm hr^{-1}. Locomotion speed and moving distance was somewhat higher in summer when food availability was also higher.

SHELL COLOUR POLYMORPHISM IN TROCHACEAN GASTROPOD *Umbonium vestiarium* (L.) FROM TELUK ALING, PENANG, MALAYSIA

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Colour patterns of Trochacean gastropod *Umbonium vestiarium* shells collected monthly from July to December 2003 from three tidal zones at Teluk Aling, Penang, were studied. The upper zone is the longest exposed to air, followed by the middle zone, while the lower zone was exposed to air for the shortest duration during the tidal movement. Seven colour morphs were found, varying from pure white to pure black. The colour morph of small dark-grey spots or stripes on a creamy-grey background is commonest. The colouration of the other common morph is more uniform. It comprised of darker bands and the colour is more intense. The rarest colour morph is pure pinkish-red with no spots or stripes. All the morphs seemed to coexist over most of the distribution area. Most *U. vestiarium* were found on the middle zone, followed by the lower zone. There was no specimen recorded in the upper zone during all the sampling months.

THE SURVIVAL RATE OF PEARL OYSTER *Pinctada maxima* USING TWO TRANSPORTATION METHODS

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Pearl oyster culture can still be considered as a new and potential shellfish culture industry in Malaysia. To date, pearl oyster farm can only be found in east cost of Sabah, East Malaysia. Transportation of livestock is a critical issue in introducing the pearl oysters to selected culture site. The objective of this study was to determine the best method in transportation of pearl oyster and also the post-transportation survival rate. Two experiments (Experiment 1 and 2) have been carried out in this study. In Experiment 1, oysters were packed dry covered with moist cloth. The oysters were then kept moist and chilled in ice-chest for almost 10 hours during the transportation process. Meanwhile, in Experiment 2, oysters were also packed dry covered with moist cloth and kept in moist and chilled condition for almost 10 hours. Before arrive the laboratory, the oysters were acclimatized in an intermediate holding tanks supplied with continuous seawater and aeration for 10 days. Oysters in the experiments where transported from Sabah to Muka Head Marine Research Station in Penang. In both experiments, oysters were acclimatized in fibre-glass tank supplied with continuous running coastal seawater and aeration daily upon arrived the laboratory. The survival of the oysters was recorded daily.

The survival rate was significantly higher in Experiment 2 with 100% of survival rate compare to Experiment 1 with 97.92% of survival rate. The results showed that Experiment 2 is the better way to transferred pearl oyster. Intermediate holding tank supplied with clean ocean seawater can help reduce stress of pearl oysters that were hold in moist and chilled condition for a long period. Future studies are needed to investigate the survival rate of pearl oysters in different culture system.

Table 1 The Survival rate of *Pinctada maxima* in two experiments.

Time length (day)	**Survival rate (%)**	
	Experiment 1	Experiment 2
1	97.92	100
2	97.92	100
3	97.92	100
4	97.92	100
5	97.92	100

HAEMATOLOGICAL STUDY OF GREEN TURTLE *Chelonia mydas* IN CAPTIVITY IN TERENGGANU, MALAYSIA

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Malaysia has been the home of marine turtles where four of the seven species have been recorded. They are green (penyu agar) *Chelonia mydas*, leatherback (penyu belimbing) *Dermochelys coriacea*, hawksbill (penyu karah sisik) *Eretmochelys imbricata* and Olive Ridly (penyu lipas) *Lepidochelys olivacea*.

Many diseases could be linked to pollution in the oceans such as oil spills, urban runoff of chemicals and petroleum. The interactions of factors that influence whether infection is expressed as clinical disease in a population can be very complex. Many of Malaysian turtles are observed to be unhealthy during nesting in beaches where many were infected with parasites, showing traumatic injuries, lethargy and emaciation. Hence, blood profile is important in revealing their health status. The objective of this study was to determine the morphology of erythrocyte size in *C. mydas.*

The method of Ismail (2003) was used to determine the sizes of erythrocyte and nucleus of turtles nesting in Malaysia. The erythrocyte and nuclear sizes and length/width ratios of *C. mydas* are given in table 1.

	EL (μ)	EW (μ)	EL/EW	ES (μ^2)	NS/ES
Maximum	23.92 ± 1.61	21.18 ± 1.43	2.06 ± 0.15	352.32 ± 33.73	0.25 ± 0.04
Minimum	14.38 ± 1.61	9.41 ± 1.43	1.00 ± 0.15	116.33 ± 33.73	0.07 ± 0.04
Mean	18.96 ± 1.61	11.98 ± 1.43	1.59 ± 0.15	179.44 ± 33.73	0.15 ± 0.04

	NL (μ)	NW (μ)	NL/NW	NS (μ^2)
Maximum	8.38 ± 0.66	6.79 ± 0.69	2.18 ± 0.18	42.55 ± 5.44
Minimum	5.04 ± 0.66	3.37 ± 0.69	0.85 ± 0.18	14.99 ± 5.44
Mean	6.81 ± 0.66	5.01 ± 0.69	1.38 ± 0.18	26.95 ± 5.44

POPULATION GENETIC STRUCTURE OF *Oreochromis niloticus* FROM BALUNG RIVER, SABAH, MALAYSIA USING SEQUENCING ANALYSIS OF CYTOCHROME C OXIDASE I (CO1) MITOCHONDRIAL DNA FRAGMENT

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A study of the genetic variation in *Oreochromis niloticus* (Nile tilapia) populations from Balung River, Tawau, Sabah was done using partial sequencing of *cytochrome c oxidase* I (CO1) mtDNA gene. A total of 21 samples were collected from three sites along Balung River. Phylogenetic analysis using neighbour-joining (NJ) and maximum parsimony (MP) methods generally divided samples into two major clades (Clade A and Clade B) supported by strong bootstrap value (100/99 for NJ and 99/99 for MP). Interestingly, both clades contained mixed samples from all three sites. Based on this it is suggested that *O.niloticus* samples from Balung River might have originated from two different mtDNA lineages (two different parental stocks), and thus could represent a hybrid population. Additionally, the low distance values (0.000 to 0.087) and low sequence divergence values (0.000 to 0.082) indicated a very close genetic relationship between samples, thus enforcing their taxonomic status as belonging to a single taxon (*O. niloticus*). The high level of gene flow (N_m=10.50) and low population structuring (F_{st}=0.05) among samples was consistent with the close geographical distances between sites.

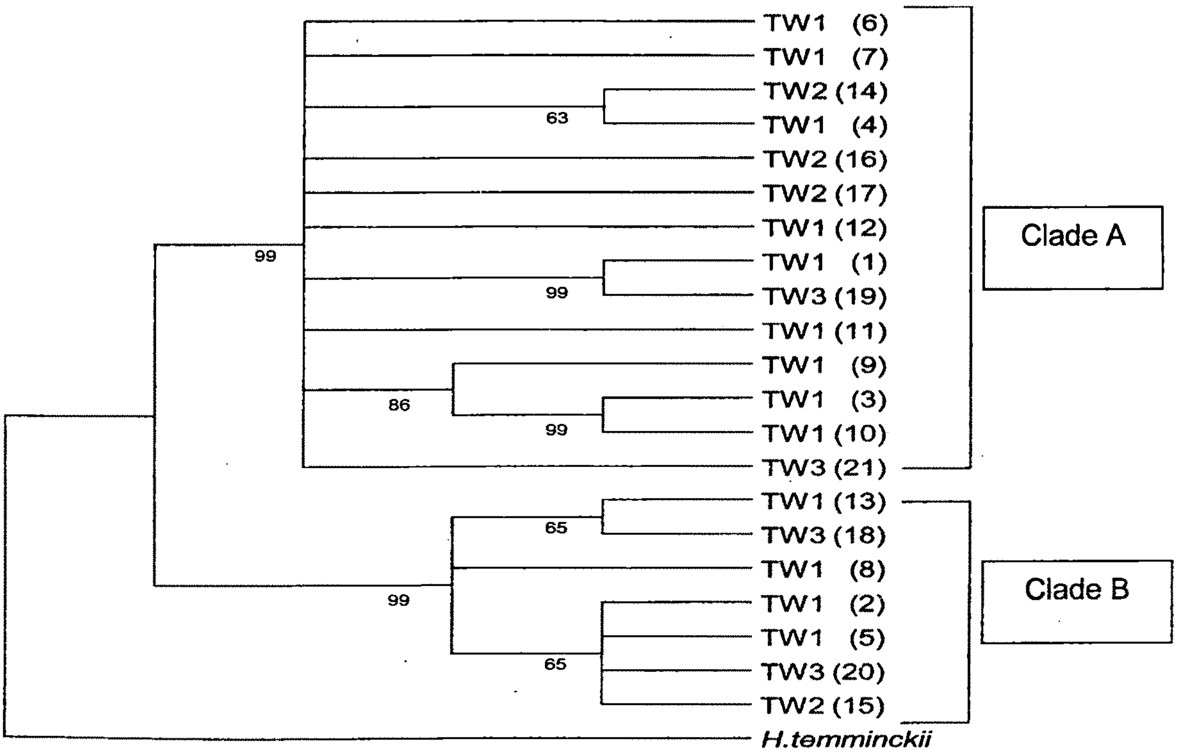

FIGURE 1 Maximum Parsimony tree (consensus tree) of *Oreochromis niloticus* samples in Balung River, Sabah inferred from *cytochrome c oxidase* I (COI) mtDNA. The tree was rooted with a sequence of *Helostoma teminckii.* Numbers at nodes indicate the bootstrap values (above 50) in percentage. Abbreviation: TW1= Site 1, TW2= Site 2, TW3 = Site 3.

A TRIAL OF TAGGING TO STUDY MIGRATION OF FISH IN THE MEKONG RIVER SYSTEM, CAMBODIA

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The Mekong River system supports a major fishery which is based primarily on migrating fishes. Many species are caught by millions of fishers operating at all scales, from subsistence to large commercial operations. Over the last decade attempts have been made to understand and document migrations of key fish species. Researchers did not use conventional mark-recapture methods because they felt that relatively few fish of each species could be tagged and few tags would be returned. Researchers have instead relied upon the local ecological knowledge (LEK) of expert fishers dispersed along the river system to piece-together migration patterns. But the results of such LEK studies have not been universally accepted as proving migration, because apparent migration "waves" may result from several alternative phenomena or artefacts. We carried out this small study to determine the viability of mark-recapture studies to supplement or confirm information from LEK interviews.

Between Oct. 2003 and Jan. 2004, 13 species of migratory Mekong fish (total n = 1,857) were tagged with external plastic tags and released. The fish were all caught by commercial dais (stationary trawls) in the Tonle Sap River, a Mekong tributary. Tag returns were obtained by surveying fishers along the main river systems up- and downstream of the tagging site. As of mid-2004, the tag-return rate was 13% (total n = 248). Actual recaptures were probably much higher, as millions of people fish at some time in this system and we could only interview a small subset of full-time fishers along mainstreams. The high rate of returns shows that fishers are willing to cooperate when contacted and provided with a small financial incentive to return tags, and also shows that fishing pressure is very high in this system. Almost all tag returns were from fish caught by gill-nets, which have recently supplanted traditional gears as the most common and effective gear. Gill nets are used now in such numbers as to present the major barrier to migrations in the system.

Most tags were returned from fish recaptured within 5 km of the tagging site, but tags were returned from seven species of fish which moved more than 5 km, and four species of fish migrated over 100 km, indicating long-distance migration. This study confirms fish movement out of the Tonle Sap and into the Mekong River during the dry season, and also confirms in general the information about migrations obtained in earlier interviews with fishers, which suggest that long-distance migrations are essential for maintenance of the Mekong's productive inland fishery. Our success in this study depended largely upon: (i) tagging at one site only where fish were concentrated (so many fish could be tagged quickly, and movement patterns would be clear), (ii) tagging only larger fish >0.5 kg (as small fish are too abundant, limiting the proportion which can be tagged or recaptured), (iii) surveying fishers over several months to get returns, and (iv) providing a small payment for each tag returned. Successful tagging programmes in larger river systems should allow for these four factors, and in particular plan and budget to communicate effectively with fishers.

FISHERY RESOURCES ASSEMBLAGE AND MANAGEMENT IN THE RIVER TITAS OF BRAHMANBARIA, BANGLADESH

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This paper presents the results of analysis of the fish assemblages in the river Titas of Brahmanbaria district in Bangladesh. Catch monitoring data from January 1997 to December 2000 covering 47 months were utilized for community structure analysis using TWINSPAN and DCA techniques. Both techniques separate the monsoon from dry season. During monsoon 34 number of species contributed 41% of the production and the most dominant species were Jatputi (*P. sophora*), Kaikla (*X. cancila*), Gol chanda (*C. nama*), Foli (*N. notopterus*) Meni (*N. nandus*) and Boal (*W. attu*). During dry season 24 number of species contributed 51% of the production and dominant species were Ruhu (*L. rohita*), Bajari tengra (*M. tengara*), Gura Icha (*N. tenuipes*), Chapila (*G. chapra*), Tara biam (*M. aculeatus*) and Kackhi (*C. soborna*). Kachki the highest contributed species followed by Jatputi and Chapila contributed 12.95%, 11.44% and 11.02% respectively of the total overall catch in the river.

YIELD OF FISH AND OTHER AQUATIC ANIMALS FROM RICE FIELDS IN BATTAMBANG PROVINCE, NEAR THE TONLE SAP LAKE, CAMBODIA

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Rice fields are an important source of fish and other aquatic animals (OAAs) for household consumption and supplementary income for a large proportion of Cambodia's population. The harvest has been conservatively estimated by previous authors at about 25-50 kg/ha/year countrywide, but there are no data for rice fields representative of those around the Tonle Sap – Great Lake system, where most of the population lives and where most rice is produced. Underestimation of the importance of ricefield fisheries means they continue to be largely ignored in development planning which focuses on increasing rice yields, often at the expense of fishery production, which may be reduced by pesticide use and isolation of fields from sources of recruitment of fish and OAAs.

This study was carried out in Battambang Province, one of five provinces which surround the famous Tonle Sap Lake, the centre of inland fish production in Cambodia. Three zones were sampled: Zone 1-lowland, next to a major river, Zone 2-lowland, further from the river but close to flooded forest, and Zone 3-slightly elevated and most distant from rivers. Yield was estimated in each zone by monitoring the harvest by villagers from 50–100 ha of rice fields during the wet season, and also by pumping water off 2-4 ha of ricefields during and at the end of the wet season and netting all the fish and other aquatic animals from the pumped area.

The recorded harvest of fish and other aquatic animals by people was 92-149 kg/ha/yr, of which 70-81% was fish. At least 26 gears were used, with most of the catch being taken by set pole and line, traditional traps and cast nets. Catches peaked as water levels fell from October to December. Catches included 43 species of fish and 6 taxa of other aquatic animals. Nine taxa formed 63% of the total catches by weight; these were fish: *Channa striata, Anabas testudineus, Macrognathus siamensis, Clarias batrachus, Trichogaster trichopterus,* and *Monopterus albus*, and OAAs: crabs, frogs and shrimps.

The zone closest to the river had twice as many species of fish as the other zones, showing the effect of seasonal migration of river fish up watercourses which drain from the ricefields to rivers. But the total harvest of fish by people was actually higher in the zone most distant from the river, because fishing pressure was higher and in that zone fish were caught more easily as they were confined to easily-fished channels by a road levee.

By pumping we obtained estimates of standing crop of 125-131 kg/ha of fish and OAAs, a range consistent with the yield estimates. As water levels recede, some fish and OAAs escape to rivers or adjacent flooded forest, where they are caught by other fishers. Allowing for such losses from the study areas, the yield of all aquatic animals could be much higher than any previous estimates, confirming the great importance of ricefields for fisheries production in Cambodia.

A FISHERIES BASELINE SURVEY IN CHAMPASAK PROVINCE, SOUTHERN LAO PDR

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Inland fisheries appear to be important throughout the Lao PDR (Laos), but little quantitative information is available. An earlier survey of Luang Prabang province in the north of the country provided baseline information representative of upland mountainous regions. To complement the Luang Prabang survey, this study was carried out in a lowland region in the south of the country during August and September of 2002. The study covered eight representative villages and 200 households. Household heads were interviewed about some important aspects of fisheries, in particular about their annual catches and consumption of fish and other aquatic animals.

In about 96% of the households, one or more family members went fishing at some time during the year; and 14% of households included at least one full-time fisher. In three of the eight villages, fishing was the 2nd most important economic activity after rice farming, whereas in the other villages fishing ranked 3rd, 4th or 6th in economic importance, with the relative importance of fishing depending upon proximity to aquatic habitat. The most important fishing gears were stationary gill nets, cast nets, drift nets and long lines. Permanent rivers were the most important habitats for fishing in both wet and dry seasons. The reported consumption of fish and other aquatic animals was about 53 kg/person/year, of which about half was fresh fish, about one quarter was processed fish, and about one quarter was other aquatic animals (OAAs - frogs, crabs, shrimps, molluscs and insects). The reported consumption was about 30% higher than that for Luang Prabang, as would be expected in a lowland area that has significant aquatic resources. Reported catches were lower than consumption, a difference possibly attributable to additional fish production from aquaculture (which however appeared to be unimportant) or purchases. Possibly household heads underestimate catches, because they may be unaware of the activities or other household members.

Our figures confirm the importance of inland fisheries for Champasak province. Official statistics appear to greatly underestimate both the importance of fishing and the production and consumption of wild fish in the Lao PDR, as is the case in Southeast Asia generally. As a result, policies and programs tend to favour other sectors or aquaculture at the expense of the wild fishery. To provide a more accurate picture of household activities national surveys could include questions about people's secondary economic activities, or questions about relative consumption of foods. Such questions would show clearly the importance of inland fisheries, which could aid in raising their profile and lend support to measures for their conservation and enhancement.

USING LOCAL FISHERS TO MONITOR THE INLAND CAPTURE FISHERIES OF THE MEKONG DELTA, VIETNAM

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The Mekong Delta in Viet Nam is densely populated and intensively farmed. The delta is traversed by nine distributary rivers, which are linked to a complex network of canals that regulate flooding and drainage. Flooding is allowed to inundate farmland for several months each year, providing prime habitats for production of wild fish. Millions of people fish at some time, using a wide range of gears, but the delta's inland fisheries are generally undervalued, as most people who fish have other primary occupations and there are few accurate data on catches or trends in the fishery.

To monitor inland fisheries using conventional approaches requires well-trained staff and the use of agency-owned and maintained equipment, including boats, sampling gears and processing facilities. Developing countries generally lack the capacity and funds for such conventional monitoring, so many researchers have obtained information by interviewing expert fishers about their local ecological knowledge (LEK), a rich source of information which can be accessed at low cost. Such fishers have many years of experience and in some cases knowledge passed down from their forbears, so they can potentially provide a great deal of integrated information on fisheries and trends in catches. But interviews about LEK may not provide reliable quantitative data, so are regarded sceptically by some people. Monitoring of fishers' catches, when supervised by agency staff, potentially provides data which are more quantitative and reliable than interview data. Such monitoring is also much cheaper than conventional monitoring as carried out by agencies.

We carried out a trial study to monitor 36 professional fishers over a period of 12 months at 18 locations in the Mekong Delta. Fishers were trained and then they recorded information about their catches by various gears every day. Fishers used many kinds of gear, but trawls and stationary trawls (days) produced the highest catches. About 160 species were caught, and we obtained valuable CPUE data for each gear which showed variations in catch over time throughout the delta, confirming that this approach is effective for long-term monitoring of inland fisheries. Such monitoring also provides useful training for agency staff and facilitates constructive interaction with fishers. During the study 16 fishers were eliminated, as their data were not reliable, showing the need for careful selection of fishers based on their level of education and commitment. Confusion over classification of some species showed a need for better national -language guides to this diverse fauna.

MONITORING OF FISH MARKETS IN THE MEKONG DELTA, VIETNAM

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The fertile delta of the Mekong River extends over about 39,000 km^2 (12% of Viet Nam's land area), supports some 17 million people, and produces about 35% of the country's agricultural output. Fish and other aquatic animals have been under-recognised as important products of the delta, because censuses record production only from larger commercial operations, whereas most of the catch may be from small-scale artisanal or subsistence fishers. Apart from the lack of accurate information on the size of the fishery, trends in the fishery are not well-monitored.

Catches, marketing or consumption can all be monitored as indicators of trends in the fishery. In this one-year study we aimed to determine the best methods for monitoring markets, the cost of such monitoring, and how well market monitoring indicates trends.

Surveys were carried out in the Mekong Delta from July 2003 to June 2004 at four inland markets and one market in a coastal province. The surveys included both daily monitoring of individual sellers and quarterly appraisals of all vendors in the market. Five full-time long-term vendors in each market were trained to use daily logbooks to record sale weights and prices/kg of each species. For the quarterly appraisal, each market was surveyed by a team who interviewed all vendors selling fresh fish and other aquatic animals each day for five days.

Sales included about 70 common species of inland fishes, about 10 species of other inland aquatic animals (shrimps, clams, snails frogs and turtles), about 40 species of marine or estuarine fishes and about 10 taxa of marine or estuarine invertebrates (clams, crabs, shrimps and cephalopods).

In the four inland markets, inland fish comprised about 60% of total weight sold; marine and estuarine fish comprised about 20% of total weight sold and other aquatic animals comprised about 20%. About 65% of inland fish were from wild capture and 35% were from aquaculture. The wild fishery is clearly of overriding significance for sales and it also provides much of the fish feed for inland aquaculture species.

In the coastal market, inland fish comprised about 30% of sales, marine and estuarine fish comprised about 45% and the remainder comprised other aquatic animals, particularly shrimps. Virtually all marine and estuarine species were reportedly from wild-capture.

The most valuable species retailed were shrimps (*Macrobrachium rosenbergii* and several penaeid species), as well as crabs and turtles, which are all being increasingly aquacultured. Most popular aquaculture fishes are now relatively low-priced, so many of the more-expensive wild fishes could provide higher returns if they could be domesticated.

We are currently analysing the daily and seasonal variation in the data which should allow us to specify the level of precision which can be obtained by sampling at different frequencies and at different intensities. These analyses will provide better information on which to plan long-term monitoring of these markets as indicators of the state of the delta's fisheries.

- Aalbersberg
  - Bill 142
- Abdolmalaki
  - Shahram 15
- Abdullah
  - S. 86
- Abella
  - Tereso 53
- Ablan
  - Ma. Carmen A. 19, 22
- Acosta
  - Belen O. 53
- Addun
  - Raymundo P. 66
- Adnan
  - N. Ahmad 40
- Agbayani
  - Eli 90
- Ahmad
  - Abu Talib 24, 25
  - Amirrudin 243
- Ahmad Arshad
  - Abd. Haris Hilmi 196
- Ahmed
  - Abu Tweb Abu 74
  - K. K. U. 88
  - Mahfuzuddin 22, 54, 56, 174, 177
  - Md. Kawser 91, 136
  - Md. Sagir 38, 238
  - Munir 92
  - Nesar 29, 68, 240
  - S. U. 88
- Ahsan
  - Md. Nazmul 125
  - Mohammad Nazmul 67
- Airin
  - Asma Haque 125
- Akandha
  - Shohidul Islam 29, 68
- Akhtaruzzaman
  - Md. 92
- Akhteruzzaman
  - Md. 91
- Akter
  - Ms. Nargis 139, 151
- Akteruzzaman
  - Md. 157
- Alam
  - Md. Ferdous 64, 163
- Alamgir
  - Md. 154
  - Mohammed 115
- Albert 186, 196
- Alcaria
  - Joselito Francis A. 132
- Aleem
  - Naseem 61
- Ali
  - Ahmad 196
  - Ahmad bin 186
  - Md. Shahadat 92
- Amarasinghe
  - Upali S. 30, 175
- Amarasiri
  - C. 188
- Ambak
  - M.A. 37, 254
- Amilhat
  - E. 27
- Amin
  - S. M. Nurul 36
- Ancog
  - Isidore 7
- Anisur
  - Rahman Md. 12
- Anrooy
  - Raymon Van 110
- Anuar
  - H.. 254
- Anwaruzzaman
  - Md. 169
- Ara
  - Mosammat Rowshan 125
- Arshad
  - Aziz 100
- Arthington
  - Angela 176
- Arunkumar
  - Y.S. 60
- Athula
  - J. A. 30
- Azam
  - Khairul 67, 70
- Azim
  - Manuara 62
- Babu
  - R. S. Nagendra 98
- Bailly
  - Denis 60, 65
- Balcombe
  - Steve 176
- Banez-Sumagaysay
  - Marieta 128
- Baran
  - Eric 34, 172
- Basavaraju
  - Y.. 63, 65
- Basher
  - M.Z. 70
- Begum
  - Taposhi Mariam 29, 68, 240
- Beung
  - Pak 145
- Bhatta
  - K. S. 48
- Bhattacharya
  - Tapati 94
- Biradar
  - R.S. 120
- Bista
  - Jay Dev 46
- Biswas
  - P.. 14
- Biusing

Rooney Edward....97, 191
Blaber
  Stephen....185
  Stephen J. M....3
Blanco
  A.P....161
Bringas
  Jose Ma. Antonio....7
Brown
  D.....59
Cabanban
  Annadel Salvio....97, 191
  Annadel Sarmiento....19
Cagauan
  Arsenia G....106
Cavanagh
  Rachel D....195
Chamsinhg
  Bounthanom....5
Chan
  K. M....95, 96
Chand
  B. K....14
Chang
  S. K....32
Chanpengxay
  Sompanh....158
Chao
  Nai-Hsien....85, 121
Chau
  Lam Ngoc....265
Cheah
  Wee....258
Chen
  Choulon Allen....19
  Meng-Hsien....121
  Yu-Huei....121
Chenkitkosol
  Wantana....152
Cherie
  Whippey-Morris....109
Chin
  Hong Yee....8
  Kam Yew....251
Choi
  Kwang-Sik....247, 256
  Young-Chan....256
Chowdhury
  Mohammad Mamun....74
  Sabuj Kumar....126, 140
Chowhan
  S.K....167
Christensen
  Steen....9, 10
Christianus
  A....87
Chu
  Ka Hou....20
Cleofe
  Jovelyn T....133
Collis
  Bill....92
Connolly
  R. M....40
Corea
  A.S.L.E....242
Costa
  Thomas....154
Cui
  Zhaoxia....20
De
  T. K....99
De Silva
  D.A.M....124
  Sena S....179
Deeburee
  Kanokporn....130, 150, 158
Dennis
  Kelvin Pudun....105, 244, 255
Dey
  Madan Mohan....69, 240
Dharmadi....189, 192
Dinh
  T.D....254
Dissanayake
  D.C.T....188
Ebbers
  Theo....143
E-Jahan
  Murshed....62
Elliott
  Mike....13
Em
  Samy....261
Erediano
  J.A....160, 161
Esa
  Yuzine B....104, 105, 244, 255, 260
Fabres
  Boris....90
Fahmi....189, 190, 192
Faruk
  Md. Ali Reza....55
Faruque
  Golam....69
Fatan
  Nurulhuda Ahmad....25
Ferrer
  Alice Joan G....118
Fong
  Patrick Sakiusa....142
  Sakiusa....39
Frangoudes
  Katia....134
Gambang
  Chuan....186, 196
Gamucci
  Olivier Delahaye....194
Garaway
  Caroline....5
Garces
  Len R....23, 24, 25, 45
Garcia
  Yolanda....239

Garforth
  Christopher 153
Garrison
  Joseph G. 182, 266
ghassemi
  Shahram 28
Giles
  B. 11, 161
  B.G. 160
  Jenny 199
Goh
  Hui Xin Amelia 19, 22
Golam
  Mustafa 262
Goswami
  A. 14
Grageda
  Maria Vivian Camacho 75
Grudphan
  Chaiwut 178, 180
Guk
  Byeong Guk 50
Gupta
  Modadugu V. 53
Gurumayum
  S.D. 135
Gurung
  Tek Bahadur 46
Haghighi
  Farokh Parafkandeh 21
Hagiwara
  Atsushi 75, 249
Hajeb
  P. 87
Hajisamae
  Sukree 44
Halder
  Sachin 92
Halim
  M. A. 36
  Rushaliza Abdul 257
  Sadeka 91, 136
Haque
  Md. Emdadul 13
  Md. Mahfuzul 17
Hartmann
  Wolf
  4, 144, 145, 130, 146, 149, 150, 158, 159
Hasan
  K. R. 88
  M. R. 43, 84
Hassan
  Marina 259
  Sulinda binti 260
Haylor
  G. 6
Heng
  E.K. 54
Hogan
  Zeb 261
Hong
  Meen Chee 54
Hoq
  M. Enamul 102
Hortle
  Kent G. 173, 182, 261, 263, 264, 265, 266
Hossain
  M. A. R. 9
Husin
  Norainy Mohd 103
Hussin
  Wan Mohd. Rauhan Wan 44
Ibrahim
  H. M. 37
  Kamaruddin 259
  Norhayati 243
  Sakri 44
Ilyas
  Mohammod 155, 166
Iqbal
  Mohammed 74
Islam
  A.M. 167
  K.M. Nurul 154
  Khan Muhammad Nurul 115
  M. Anisul 155, 166, 168
  M. Nazrul 102
  M. Serajul 57
  S. 59
Israel
  Danilo C. 2, 54, 56
Jaaman
  Saifullah A. 33
Jafri
  Jamaludin 100
Jahan Tareq
  Mohammod Sharoar 155, 166, 168
Jana
  T. K. 99
Jang
  In Kwon 20
Janssen
  Johannes 61, 64
Jayasinghe
  R. P. P. K. 8
  U. Asanka D. 30
Jayathilaka
  R.A.M. 188
Jee
  Chandrawati 93
  Janardan 93
Joshi
  Ravindra C. 106
Jutagate
  Tuantong 178, 179, 180
Kabir
  M. Iqbal 165
Kafarowski
  Joanna 137
Kalbassi
  M.R. 253
Kamal
  Khandokar M. Shameem 64
  Shameen 62

- Kamaruddin
  - I ... 86
- Kamil
  - Anton Abdulbasah ... 239
- Kandar
  - Mohd. Norhalim ... 259
- Kang
  - Do-Hyung ... 247, 256
- Karim
  - Md. Reazul ... 61
- Karmoker
  - A ... 9
- Karzakram
  - Unnayan ... 141
- Kashem
  - Md. Abul ... 64
- Kassim
  - Zaleha ... 44
- Katti
  - R. J. ... 98
- Kaymaram
  - Farhad ... 49
- Kazunari ... 186
- Keang Seng ... 174
- Khader
  - Vijaya ... 119
- Khan
  - Mahbubur Rahman ... 183
  - Shakil Ahmed ... 164
- Khim
  - Kaing ... 130, 146
- Khumsri
  - Malasri ... 158
- Kiabi
  - Bahram ... 49
- Kibria
  - Md. Ghulam ... 16, 110, 114
- Kim
  - Dae Choul ... 41
  - Hyeong Seok ... 50
- Kimchhea
  - Chhoun ... 158
- Kiso
  - Katsuhiro ... 246
- Koh
  - Johnson Ching Chern ... 250
- Koo
  - Kwi Yeon ... 50
- Korovulavula
  - Isoa ... 39
- Kristina
  - Fidali-Hickie ... 109
- Kumar
  - Y.S. Arun ... 63, 65
- Kuppan
  - Perumal ... 100
- Kurup
  - B. Madhusoodhana ... 42, 89, 245
- Kusakabe
  - Kyoko ... 122
- Lah-Anyi
  - Yuhana U. ... 33
- Lam
  - Thanh Pham ... 182
- Lamkom
  - Thanatip ... 178, 180
- Larson
  - H.K. ... 198
- Last
  - P.R. ... 194, 198
- Laureta
  - Liberato V. ... 47
- Lavides
  - Margarita ... 7
- Law
  - Ah Theem ... 250, 251
- Leaño
  - Eduardo M. ... 26
- Lee
  - Byung-Gul ... 256
  - Chun Woo ... 50
  - Gun Ho ... 50
  - Gwang H. ... 41
  - Ju Hee ... 50
- Leelapatra
  - Wattana ... 4
- Liao
  - I Chiu ... 26
- Liepvisay
  - Nouhak ... 130
- Lim
  - Chai Fong ... 196
- Lin
  - Y. T. ... 32
- Little
  - David C. ... 69, 72
- Loneragan
  - N. R. ... 40
- Lorenzen
  - Kai ... 5, 27
- MacKay
  - Kenneth T. ... 18
- Mahmud
  - Rohani ... 243
- Mair
  - G.C. ... 63
- Malvas
  - Sammy ... 143
- Man
  - Alias ... 24
- Mangada
  - Ladylyn Lim ... 156
- Manjaji
  - B. Mabel ... 191, 198
- Manson
  - F. J. ... 40
- Mao
  - Sokanyn ... 182
- Marcial
  - Helen S. ... 249
- Marriot
  - Alan ... 67
- Masagca
  - Jimmy T. ... 112

Matsuda
  Yoshiaki 147, 148
Mazid
  M. A. 88
Mazlan
  I... 86
Mazumder
  Debashish 31
McCorry
  D... .... 11, 160, 161
McGilvray
  Frazer 52
Menasveta
  Piamsak 252
Meo
  Semisi 39
Michael
  R. Dinakaran 248
Miller
  Margaret 197
Minamimoto
  Masako 75
Minh
  Truong Hoang 9, 10
Mishra
  S. 48
Mitchell
  Jean 113
Morgan
  S. 11
Morrice
  C. P. 59
Morshed
  Sakiul Millat 141
Mostafaii
  A. 253
Mowla
  Runia 16, 110, 114
Mukherjee
  S.C. 120
Mukhopadhay
  P. K. 14
Mukta
  T. A. 9
Murray
  F.J. 72
Murshed-e-Jahan
  Khondker 64
Musa
  Najiah 259
Mustafa
  M.G. 183
Namisi
  Paul W. 170
Nandeesha
  M.C. 129, 135
Naveratne
  Y. 72
Navy
  Hap 174, 177
Ng
  C. K. 87
Ngamphongsai
  Chansawang 252
Ngamsnae
  Praneet 178, 180
Nguyen
  Thi Bich 130, 149
Nguyen-Khoa
  Sophie 5
Novaczek
  Irene 117, 123
Nuov
  Sam 263
Pak
  A. P. 96
Palaniappan
  Shamala 22
Palfreman
  Andrew 67
Pan
  A. H. 95
Panes
  H. 11
Paraguas
  Ferdinand J. 239
Pattnaik
  A. K. 48
Payooha
  Kanjana 178, 180
Penman
  D.J. 63
Phen
  Chheng 34
Phounsavath
  Sommano 145, 150, 159
Phounvisouk
  Latsamy 101
Phouthavongs
  Kaviphone 264
Phuong
  N.T. 254
  Trung Ha 158, 159
Pierce
  Graham J. 33
Pillai
  V. N. 35
Pillans
  Richard 187, 197, 198
Ponniah
  A. G. 103
Pouya
  M.A. 253
Powtongsook
  Sorawit 252
Prabakaran
  M. 248
Pushpalatha
  K. B. Chandrani 30
Rab
  Mohammed A. 45, 174, 177
Radhakrishnan
  K. V. 89
Rahim

Khairul Adha A. 104, 105, 244, 255
Rahman
  M. Mokhlesur.....................................167, 168
  Md. Abdur 126
  Md. Anisur...17
  Sushmita 29, 68, 240
Ramachandran
  A...181
Rashid
  M. Harun-Ar..57
  Zulkafli Abdul...103
Ray
  Kamal...94
Rayan
  Wirawan..182
Razak
  A...186
Reddy
  H. R. V. 98
Remesan
  M.P..181
Reyes
  Rodolfo Jr...90
Rius
  Josephine...90
Rodriguez Jr.
  Basilio M. 53
Roth
  Troeung..263
Saad
  C. R...87
Sade
  Ahemad..196
Saha
  J. K..84
Saintilan
  Neil..31
Sakakura
  Yoshitaka 75
Salam
  M. A...9
Salayo
  Nerissa...45, 153
Salini
  John 187
Sanitchon
  Anupong...173
Sano
  Masaaki..147
Satria
  Arif...147, 148
Savage
  W...6
Seenappa
  D.. ....60, 65
Seng Leang..174
Seo
  Young Kyo 41
Sereyvath
  Prak..122
Sevilleja
  Ruben C. 53
Sharma
  Arpita 120
Shastha
  Shikkha 141
Shelly
  Anwara Begum 115, 154
Shiao
  J. C. 32
Shitan
  Mahendran..8
Siason
  Ida M. 162
Siddagangaiah...63
Siebert
  Darrell 5
Siet
  Huei 145
Silva
  D.A.M. De 71
  Sena S. De..30
Silvestre
  Geronimo 24
  Gerry..22
Singhanouvong
  Douangkham......................................182, 264
Sollahuddin 186
Somboon..101
Song
  Jun-Im...247
Sopha
  Lieng 263
Srinath
  Krishna...111
Sriputinibondh
  Napaporn 122, 130
Steinhagen
  Dieter 248
Stevens
  J.D. 198
Stobutzki
  Ilona 22, 24, 25, 185
Suang
  Nam 145
Subade
  Rodelio F..58
Sujon
  Nurul Haque..141
Sullivan
  Leah...116
Sulong
  Nazuki..259
Sumadhiharga
  Kurnaen 190
Suntornratana
  Ubolratana 122, 173
Susilowati
  Indah..131
Tabthipwon
  Pratak 179
Tach
  Phanara 261
Talukder

M. M. R. 43
Tan
Aileen Shau-Hwai 257, 258
Tarisesei
Jean 117
Tayamen
Melchor 53
Tekanene
Maere 127
Thi
Dang Van 9, 10
Thomas
Joice V. 42
Thorburn
D.C. 198
Tiburcio
Fernando 7
Tien
Doan Van 265
Torell
Magnus 4
Torrechilla
A.M. 160
Trang
Hang Kim 266
Tripathi
S. D. 6
Trong
Nguyen Van 265
Tsai
Fu Ning 85
Tse
C. Y. 95, 96
Tull
Malcolm 193
Tura
Chona M. 132
Tzeng
W. N. 32
Uddin
M. Shahab 37
Uglow
Roger 252
Vasudevappa
C.. .... 60, 65
Veitayaki
Joeli 39, 142
Vieira
Simon 193
Vincent
A.C.J. 11, 160
Viriyasakultorn
Vitoon 144
Viswanathan
K. Kuperan 45, 153, 163, 183
Wagle
Suresh Kumar 46
Wahab
M. Abdul 102
Wang
Shih Ya 85
White
W.T. 189, 192
Widodo
J... .... 189, 195
Wijenayake
W. M. H. Kelum 30
Williams
Robert J. 31
Wilson
Douglas Clyde 9, 10
Wong
C. K. 95, 96
O. N. 96
Yamao
Masahiro 71, 124, 152
Yanagawa
H.. 37
Yano 186
Yasin
Zulfigar 257, 258
Yeo
Bee Hong 54, 56
Yong
Jaw Chuen 250
Young
James A. 69
Yunanda
Trian 194
Yusoff
Fatimah Md. 100
Zahura
Israt 62
Zainal
Aznan 186
Zulkifli
T. 86

A

Astriclypeus manni
  ecological study, 256

anaemia
  adaptational fish, 82

Apocyclops dengizicus
  culture laboratory, 83

aquaculture
  development
    gender Thailand, 116
  impact
    fish farmer Bangladesh, 57
  killifish mangrove model, 75
  loss diseases Bangladesh, 55
  pond extension model, 59
  stock enhancement *Anadara* Malaysia, 219
  sustainable
    DSAP Bangladesh, 62
    livelihood gender Vietnam, 110
  tunicate, 77
  women involvement Taiwan, 121

aquatic plant
  distribution endemic endangered Sri Lanka, 242

Arctic
  management resource, 137

Asia
  chondricthyan conservation, 185
  fisheries
    management shad, 3
    sustainability, 52

assemblages
  fish variation Copper Creek, 176

Australia
  fish assemblage Copper Creek, 176
  record *Glyphis* & *Lamiopis*, 198
  sawfish catch Northern, 199
  shrimp stock enhancement research, 216
  spiny lobster production enhancement, 217
  stock fishing closure, 31
  sustainability shark & rays, 187

B

Bangladesh
  aquaculture
    loss diseases, 55
    marketing, 69
    sustainable DSAP, 62
  co-management projects, 168
  conservation
    small indigenous species, 91
  fish
    breeding & migration beel, 88
    catch assessment, 29
    demand household pattern, 240
    fauna beel, 84
    processing women traditional, 126
    trade contribution & income, 67
  fisheries
    education & research, 239
    gender, 114
    management, 262
    management beel, 232
    management community, 16, 140
    management mangroves, 13
    women involvement, 136
  fishery
    aggregating device Katha, 183
    brush & vegetation park, 38
  management
    Gudusia, 17
    Tenualosa, 12
  mangrove
    shellfish structure distribution, 102
  marketing
    freshwater prawn, 68
  mollusk governance, 9
  pond aquaculture extension, 59
  population parameters *Crassostrea*, 36
  shrimp
    processing women, 125
    processing worker livelihood, 157
  taxonomic *Scylla*, 74

Bay of Bengal
  phytoplankton bloom, 99

benthic
  abundance Malaysia, 44
  fauna dam Mun River, 180
  macro communities India, 98

biodiversity
  coastal gender, 111
  impact stocking indigenous, 43
  impact trawling India, 224
  information system conservation, 90
  threatened freshwater fish India, 89

biology
  bagrid catfish, 76
  tunicate aquaculture, 77

Brachionus plicatilis
  impact diazinon, 249

breeding
  freshwater fish beel Bangladesh, 88

C

Caesio cuning
  population genetics, 22

Cambodia
  fish trade women Thailand, 122
  fisheries
    freshwater, 172
    inland marketing, 174
    management, 34
    management community, 170
    management conflict India, 153

carp
  polyculture *Macrobrachium*, 64

Caspian Sea
  fisheries management, 15
  invasive species fisheries, 21

catfish
  conservation India, 76

Channa punctatus
  thyroid interrenal pollutant, 94

Channa striata
  population dynamics, 27

Chelonia mydas
  haematological study captive, 259
  temperature incubation, 86

children
  management
    mussel oyster Philippines, 112
  sex nutritional status Guimaras, 118

Chile
  coastal management, 223

China
  stock enhancement *Fenneropenaeus*, 215

Chlorophthalmus bicornis
  biology distribution, 225

chondricthyan
  management & conservation Asia, 185

clam
  infection seasonal Korea, 79

coastal
  fisheries
    management Bangladesh, 16
  fishery forecasting, 35
  management
    community Thailand, 152
    fishing community Chile, 223
    resources Philippines, 2

community
  fisheries
    management Bangladesh CBFM, 16, 154, 155, 163, 165, 166, 167
  fishing
    development social actor, 156
  monitoring seahorse fishery, 160

conservation
  bagrid catfish India, 76
  chondricthyan Asia, 185
  small indigenous species Bangladesh, 91

copepod
  growth & production salinity, 83

Crassostrea
  gigas parasite, 81
  iredalei pyrene bioaccumulation
  depuration, 251
  madrasensis population Bangladesh, 36

cryopreservation
  freshwater fish Taiwan, 85

D

dam
  benthic fauna Mun River, 180
  fisheries Mun River Thailand, 178

demersal resources
  South & Southeast Asia, 24

diazinon
  impact rotifer, 249

diseases
  loss aquaculture Bangladesh, 55

DSAP
  sustainable aquaculture Bangladesh, 62

E

echinoderm
  association mussel, 80
  distribution Malaysia, 78

economic value wetland, 92

ecophysiological
  adaptation freshwater fish, 82

ecosystem health indicator fisheries
  Vietnam, 10

Ecteinascidia thurstoni
  biology aquaculture, 77

elasmobranch
  fisheries sustainability Indonesia, 197
  record species Malaysia, 186
  resource Sabah Malaysia, 191

Epinephelus coioides
  indicator suspended sediment, 96
  response suspended sediment, 95

export seafood South Asia, 71

F

farmer
  aquaculture impact, 57
  socio-economic India, 63

Fenneropenaeus chinensis
  stock enhancement China, 215

Fiji Islands fishing management, 142

finfish
  stock enhancement Japan, 209

fish
  aggregating device Bangladesh, 183
  assemblage
    Bangladesh, 262
    variation Copper Creek, 176
  catch assessment Bangladesh, 29
  community
    socio-econnomic Bumbung Lima, 233
  consumption
    estimation Mekong, 182
  demand
    household pattern Philippines & Bangladesh, 240
  distribution breeding South China Sea, 228
  diversity
    freshwater socio-economic Sarawak, 244
    headwater stream Trengganu, 243
  exotic
    impact ecosystem, 106
  farming
    integrated Makhana, 93
  fauna beel Bangladesh, 84
  food item Trengganu, 229
  freshwater
    community Sarawak, 255
    ecophysiology, 82
  gathering
    artificial reef Korea, 226
  genetic diversity native introduced species, 104
  inland consumer preferences, 72
  migration
    Mekong, 261
    Mun River, 179
    breeding Bangladesh, 88
  production systems
    women, 128
  sanctuary management, 164
  threatened species India, 89
  trade Kiribati, 127

fisheries
  artisanal
    shark & ray Indonesia, 189
  assessment
    catch monitoring Thailand, 173
  co-management
    economics, 159
  forestry, 144
    Lao, 145
    marketing Thailand Lao, 150
    regulation enforcement, 162
    rights-based, 143
  community poverty reduction, 141
  conflict Southeast Asia, 45
  conservation reef Philippines, 58
  cultured-based Sri Lanka, 30
  dam Mun River Thailand, 178
  dolphin dugong Malaysia, 33
  education & research Bangladesh, 239
  elasmobranch artisanal Indonesia, 192
  fisherwomen European, 134
  freshwater Cambodia, 172
  gender
    Bangladesh, 114
    education research development, 129
    management Vanuatu, 117
    Mekong, 130
    nutrition occupational health, 120
  impact irrigation rice farm, 5
  inland
    enhancement Southeast Asia, 211
    marketing Cambodia, 174
    monitor Mekong, 265
  knowledge India, 14
  management
    alternative income, 146
    Bangladesh, 262
    beel Bangladesh, 232
    Caspian Sea Iran, 15
    community Bangladesh, 16, 140
    community Cambodia, 170
    community CBFM 154, 155, 163, 165, 166, 167
    conflict, 153
    conflict Cambodia India, 153
    credit & savings, 149

- decentralization Indonesia, 148
- information yield, 158
- mangroves Bangladesh, 13
- media, 151
- reservoir Sri Lanka, 175
- seahorse Philippines, 11
- shad Asia, 3
- taxonomy Cambodia, 34
- women, 139
- marine forecast Malaysia, 8
- organisation Mekong, 4
- policy India, 6
- resources
  - impact fishing practices, 236
  - Malaysia, 25
  - pelagics Malaysia, 37
- restocking Trochus & Holothuria, 205
- shrimp ecosystem health indicator, 10
- status coral reef Malaysia, 97
- stock enhancement population dynamics, 204
- survey baseline Lao, 264
- sustainability
  - Asia 52
  - elasmobranch Indonesia, 197
  - Pacific 18
- women
  - involvement, 115, 121,136
  - policies Philippines, 133
  - raditional belief custom, 135

fisherwomen
- European recognition, 134

fishery
- bluefin tuna Indian Ocean, 32
- brush & vegetation Bangladesh, 38
- dogfish shark Sri Lanka, 188
- fish aggregating device Bangladesh, 183
- forecasting satellite, 35
- resource improvement, 48
- seahorse monitoring community, 160
- shark
  - artisanal Indonesia, 192
  - Indonesia, 190
- Shrimp sustainability, 238

fishing
- development community social actor, 156
- ethnometeorolical knowledge Philippines, 222
- gear design computerised, 50
- management Fiji, 142
- method maadevalayal India, 181
- practices impact resources, 236
- socio-economic shark & ray Indonesia, 193
- women Kiribati, 113

FLMMA
- network resource management, 39

forestry
- co-management fisheries, 144

G

gender
- aquaculture
  - development Thailand, 116
  - livelihood Vietnam, 110
- coastal biodiversity, 111
- development Philippines, 132
- fish production, 128
- fisheries
  - education research development, 129
  - mainstreaming Mekong, 130
  - nutrition occupational health, 120
  - problem challenge Bangladesh, 114
  - Vanuatu, 117

genetic
- differentiation reef fish, 19
- diversity impact introduced species, 104
- linkages *Caesio*, 22
- research and development Philippines, 53
- resource fish aquaculture ornamental India 245
- variation
  - *Penaeus chinensis*, 20
  - tilapia Sabah, 260

giant clam restocking, 210

Glyphis record Southeast Asia Australia, 198

Gudusia chapr biology & management Bangladesh, 17

Guimaras nutritional sex status children, 118

H

habitat relation abundance fish, 237

Hampala macrolepidota partitioning reservoir Kenyir, 231

Hawaii *Polydactylus* catch rates, 212

heavy metal
- concentration shrimp farm Malaysia, 230

Helicophagus waandersi migration Mun River, 179

Helostoma temminckii establishment impact, 105

Hokkaido
  scallop stock enhancement, 208

Holothuria scabra
  restocking & fisheries, 205
  restocking modelling, 206

horseshoe crab
  survey Malaysia, 87

I
India
  conservation bagrid catfish, 76
  fish resource aquaculture ornamental, 245
  fisheries
    knowledge, 14
    management conflict Cambodia, 153
    policy people, 6
  fishing method Maadevalayal, 181
  impact trawling, 42, 224
  macrobenthic communities Swarna, 98
  shrimp fishery sustainability, 238
  shrimp farming, 60, 65
  trawling Foraminefera & Harpacticoida, 221
  women fisheries traditional, 135

Indian Ocean
  fishery bluefin tuna, 32

Indonesia
  fisheries
    management decentralization, 148
    shark & ray, 189
    shark NPOA, 195
  fishing socio-economic shark & ray, 193
  women fishing community, 131

information system
  biodiversity conservation, 90

introduced species
  establishment socio-economic *Helostoma*, 105
  impact genetic native species, 104

invasive species
  Mnemiopsis fisheries Caspian Sea, 21

invertebrates
  restocking & stock enhancement, 201

Iran
  Fisheries management Caspian Sea, 15

Irrigation impact fisheries, 5
ITK
  Indigenous Technical Knowledge
    fisheries, 14

J
Japan
  finfish stock enhancement, 209
  stock enhancement *Marsupenaeus*, 214

K
Kenyir
  reservoir *Hampala* partitioning, 231

Kiribati
  fish trade, 127
  fishing women, 113

Korea
  artificial reef fish gathering, 226
  clam seasonal infection, 79
  typhoon impact coral, 247

L
Lamiopsis
  record Southeast Asia Australia, 198

landing
  prawn mangrove Malaysia, 40

Lao
  fisheries
    co-management, 145
    survey baseline, 264
  prawn study, 101

Litopenaeus vannamei tagging, 26

Lutjanidae
  habitat utilization mangrove, 246

M
Maadevalayal
  fishing method India, 181

mackerel
  metapopulation structure, 203
  stock determination South China Sea, 234

macrobenthos
  impact bottom trawling, 42

Macrobrachium rosenbergii
  polyculture carp efficiency, 64

Makhana
  integration fish farming, 93

Malaysia
  aquaculture *Anadara* stock enhancement, 219
  benthic seasonal abundance, 44

  echinodermata distribution Malacca, 78
  elasmobranch resource Sabah, 191
  elasmobranch species record, 186
  fisheries
    dolphin dugong, 33
    marine forecast, 8
    pelagics, 37
    reef status, 97
    resources, 25
  landing
    prawn mangrove, 40
  reef fish seasonal abundance, 227
  shark catches, 196
  shrimp
    farm heavy metal, 230
  survey
    horseshoe crab, 87
  tilapia estabishment reservoir, 103
  turtle egg incubation East Coast, 86

management
  chondricthyan Asia, 185
  coastal
    community Thailand, 152
    fishing community Chile, 223
  co-management project Bangladesh, 168
  fish health stocking, 207
  fish sanctuary, 164
  fisheries
    alternative income, 146
    beel Bangladesh, 232
    Caspian Sea Iran, 15
    CBFM, 165
    co-management
      economics, 159
      forestry, 144
      Lao 145
      marketing, 150
      regulation, 162
      rights based, 143
    community
      Bangladesh, 16, 140, 163
    CBFM, 154, 155
    conflict Cambodia India, 153
    credit & savings, 149
    decentralization Indonesia, 148
    information, 158
    mangrove Bangladesh, 13
    media, 151
    reservoir Sri Lanka, 175
    shark policy Southeast Asia, 194
  marine proctected areas Philippines, 161
  resource
    local knowledge value Artic, 137
    partnership FLMMA, 39
    planning Mekong, 56
  sanctuary
    marine Philippines, 7
  strategies
    Tenualosa Bangladesh, 12

mangrove
  biology killifish, 75
  habitat utilization Lutjanidae, 246
  management fisheries Bangladesh, 13
  prawn landing Malaysia, 40
  structure & distribution Bangladesh, 102

marine
  plant medicinal women development, 123

marine protected area
  resources ownership, 147

marketing
  aquaculture
    interaction & impact poor, 69
  fisheries
    inland Cambodia, 174
  sustainable
    freshwater prawn Bangladesh, 68

Marsupenaeus japonicus
  stock enhancement *MArsupenaeus*
    Japan, 214

Mekong
  aquatic resources socio-economic, 177
  fish market monitor, 266
  fish consumption estimation, 182
  fish migration, 261
  fisheries
    gender mainstreaming, 130
    monitor, 265
    organization TAB, 4
  management resources, 56
  Pseudapocryptes ibiology, 254
  resources aquatic, 54

model
  ARIMA forecast ARIMA, 8
  habitat parameters fish abundance, 237

mollusks
  harvest coastal Bangladesh, 9

monitor
  fisheries Mekong, 265
  market fish Mekong, 266

Morulius chrysophekadion
  migration Mun River, 179

N

Nepal
  rice fish farming, 46
nutrient, 100
  level changes reservoir, 100
  phytoplankton bloom, 99
nutritional status

- children Guimaras, 118
- fisherwomen India, 119

O

Octopus dollfusi
  - population biology, 235

Oreochromis
  - immune response tannery, 248
  - population genetic structure Sabah, 260

P

Pacific
  - Fisheries sustainable, 18

parasite
  - occurence *Crassostrea*, 81

Patinopecten yessoensis
  - stock enhancement scallop Hokkaido, 208

Penaeus chinensis
  - genetic variation, 20

Penaeus monodon
  - nitrate protein concentration haemolymph, 252

Penaeus semisulcatus
  - population dynamics, 28

Persian Gulf
  - population dynamics *P. semisulcatus*, 28

Philippines
  - Fish demand household pattern, 240
  - fish income distribution, 66
  - fisheries
    - management seahorse, 11
    - reef conservation, 58
  - fishing
    - ethnometeorological, 222
  - gender development, 132
  - management
    - coastal, 2
    - marine sanctuary, 7
    - mussel oyster farm, 112
  - marine proctected areas
    - management, 161
  - research & development genetics, 53
  - status Pholadidae, 47

Pholadidae
  - status prospects Philippines, 47

phytoplankton
  - bloom nutrient Bay of Bengal, 99

Piaractus brachypomus
  - impact rice ecosystem Philippines, 106

Pinctada maxima
  - survival transportation, 258

policy
  - fisheries
    - India, 6

pollutant
  - Channa, 94

Polydactylus sexfilis
  - catch rate Hawaii, 212

poor
  - aquaculture marketing impact interaction, 69
  - biology & management *Gudusia*, 17
  - governance coastal Bangladesh, 9

population
  - biology octopus Prachuap, 235
  - dynamics
    - *Channa* rice farm, 27
    - fisheries stock enhancement, 204
    - *Penaeus semisulcatus* Persian Gulf, 28
    - *Tenualosa*, 12
    - *Thunnus* Oman Sea, 49
  - parameters
    - *Crassostrea* Bangladesh, 36
  - stock determination mackerel South China Sea, 234
  - structure
    - *Caesio*, 22
    - metapopulation mackerel, 203
    - spatial restocking, 202

prawn
  - culture socio-economic Bangladesh, 241
  - study Lao, 101

Pseudapocrypte lanceolatus
  - biology coastal MEkong, 254

pyrene
  - bioaccumulation depuration oyster, 251

R

Rastrelliger kanagurta
  - stock determination South China Sea, 234

ray
  - fishery artisanal Indonesia, 189
  - sustainability Australia, 187

reef
  - artificial
    - fish gathering Korea, 226
    - image sonar, 41
  - conservation fisheries Philippines, 58

  fish
    genetic differentiation, 19
    seasonal abundance Malaysia, 227
  fisheries
    status Malaysia, 97

reservoir
  nutrient level changes, 100
  tilapia establishment Malaysia, 103

resource
  allocation polyculture Bangladesh, 64
  elasmobranch
    Sabah Malaysia, 191

resources
  aquatic
    Mekong, 54
    socio-economic Cambodia, 177
  fisheries Malaysia, 25
  fishery improvement, 48
  ownership marine proctected area, 147

restocking
  fisheries *Trochus* & *Holothuria*, 205
  giant clam, 210
  marine invertebrate, 201
  modelling *Holothuria*, 206
  spatial population structure, 202

rice
  farming irrigation fisheries, 5

rice field
  fish yield Tonle Sap, 263
  stock size density fertilizer, 46

Rivulus marmoratus
  biology, 75

Ruditapes philippinarum
  infection Korea, 79

Rutilus frisii kutum
  serum immunoglobin purification, 253

S

Sabah
  tilapia population genetic, 260

Sarawak
  freshwater fish
    community, 255
    diversity socio-economic, 244
Sawfish
  catch Northern Australia, 199

Scylla
  taxonomic status Bangladesh, 74

Scylla paramamosain
  stock indentification, 218

seafood
  export South Asia, 71

seahorse
  fisheries management Philippines, 11

shark
  catches Malaysia, 196
  fisheries
    management national plan Indonesia, 195
    management policy Southeast Asia, 194
  fishery
    artisanal Indonesia, 189, 192
    dogfish Sri Lanka, 188
    Indonesia, 190
  sustainability Australia, 187

shell
  colour polymorphism Penang, 257
  Solomon Islands, 109

shellfish
  structure & distribution mangrove, 102

shrimp
  farm
    heavy metal Malaysia, 230
  farming
    characteristics India, 60
    Supreme Court India, 65
  processing
    women Bangladesh, 125
    worker livelihood Bangladesh, 157
  quality
    improvement, 70
  stock enhancement research Australia, 216

socio-economic
  aquatic resources Cambodia, 177
  assessment Bumbung Lima, 233
  fish farmer
    characterisation India, 63
    impact aquaculture, 57
    livelihood shrimp distribution, 70
  fisheries South & Southeast Asian, 23
  fisherwomen India, 119
  fishing shark ray Indonesia, 193
  potential freshwater fish Sarawak, 244
  prawn culture development Bangladesh, 241

Solomon Islands
  shell fisheries, 109

sonar
  images artificial reefs, 41

South Asia
  seafood export, 71

South China Sea
  fish distribution breeding, 228
  mackerel stock determination, 234

Southeast Asia
  fisheries
    conflict, 45
    shark management policy, 194
    stocking enhancement, 211
    record *Glyphis* &, 198
Southeast Asian seas
  fisheries management, 23

species
  composition
    demersal South Asian seas, 24

spiny lobster
  enhancing production Australia, 217

Sri Lanka
  endemic endangered aquatic plant, 242
  fisheries
    cultured-based, 30
    reservoir management, 175
  fishery
    dogfish shark, 188
  inland fish consumer preference, 72
  seafood
    processing women, 124
stock
  effect fishing closure Australia, 31

stock enhancement
  aquaculture *Anadara* Malaysia, 219
  Fenneropenaeus China, 215
  fisheries population dynamics, 204
  marine finfish Japan, 209
  marine invertebrate, 201
  scallop Hokkaido, 208
  shrimp research Exmouth Gulf, 216
  spatial population structure, 202
  stocking effectiveness *Marsupenaeus* Japan, 214
  Taiwan, 213

stock identification
  Scylla contribution commerical catch, 218

stocking
  fish health management, 207

stocking enhancement
  fisheries
    inland Southeast Asia, 211
strategy
  management marine sanctuary, 7
survey fisheries Lao, 264
suspended sediment
  biochemical response *Epinephelus*, 95
  indicator sublethal *Epinephelus*, 96
sustainability
  shark & rays Australia, 187
sustainable
  marketing freshwater prawn Bangladesh, 68

T

TAB
  fisheries management, 4

tagging
  Litopenaeus vannamei, 26

Taiwan
  stock enhancement, 213
  women
    fisheries aquaculture, 121

tannery
  immune response tilapia, 248

tar balls
  distribution composition Trengganu, 250

taxonomic status
    Scylla
      Bangladesh, 74

taxonomy
  fisheris management, 34

technology
  dissemination WorldFish Bangladesh, 61

Tenualosa
  fisheries
    management Asia, 3

Tenualosa ilisha
  population dynamics biology, 12

Terengganu
  fish diversity headwater stream, 243
  fish food item, 229
  tar ball distribution composition, 250

Thailand
  aquaculture
    gender involvement, 116
  benthic fauna Mun River, 180
  biology tunicate, 77
  coastal

    management community, 152
  fish migration Mun River, 179
  fish trade
    women Cambodia, 122
  fisheries
    dam Mun River, 178
    monitoring catch, 173
  population dynamics *Channa*, 27

Thunnus albacares
  population dynamics Oman Sea, 49

Thunnus maccoyii
  fishery Indian Ocean, 32

tilapia
  establishment reservoir Malaysia, 103

Tonle Sap
  socio-economic aquatic resources, 177
  yield fish rice fields, 263

trade
  fish
    distribution & contribution Bangladesh, 67
    income distribution Philippines, 66
    Kiribati, 127
    women Cambodia Thailand, 122

trawling
  Foraminefera & Harpacticoida India, 221
  impact
    macrobenthos India, 42
  impact biodiversity India, 224

Trochus niloticus
  restocking & fisheries, 205

typhoon
  impact coral Korea, 247

U-Y

Umbonium vestiarium
  shell polymorphism, 257

Vanuatu
  Fisheries gender management, 117

Vietnam
  aquaculture
    livelihood gender, 110
  fisheries
    shrimp ecosystem, 10

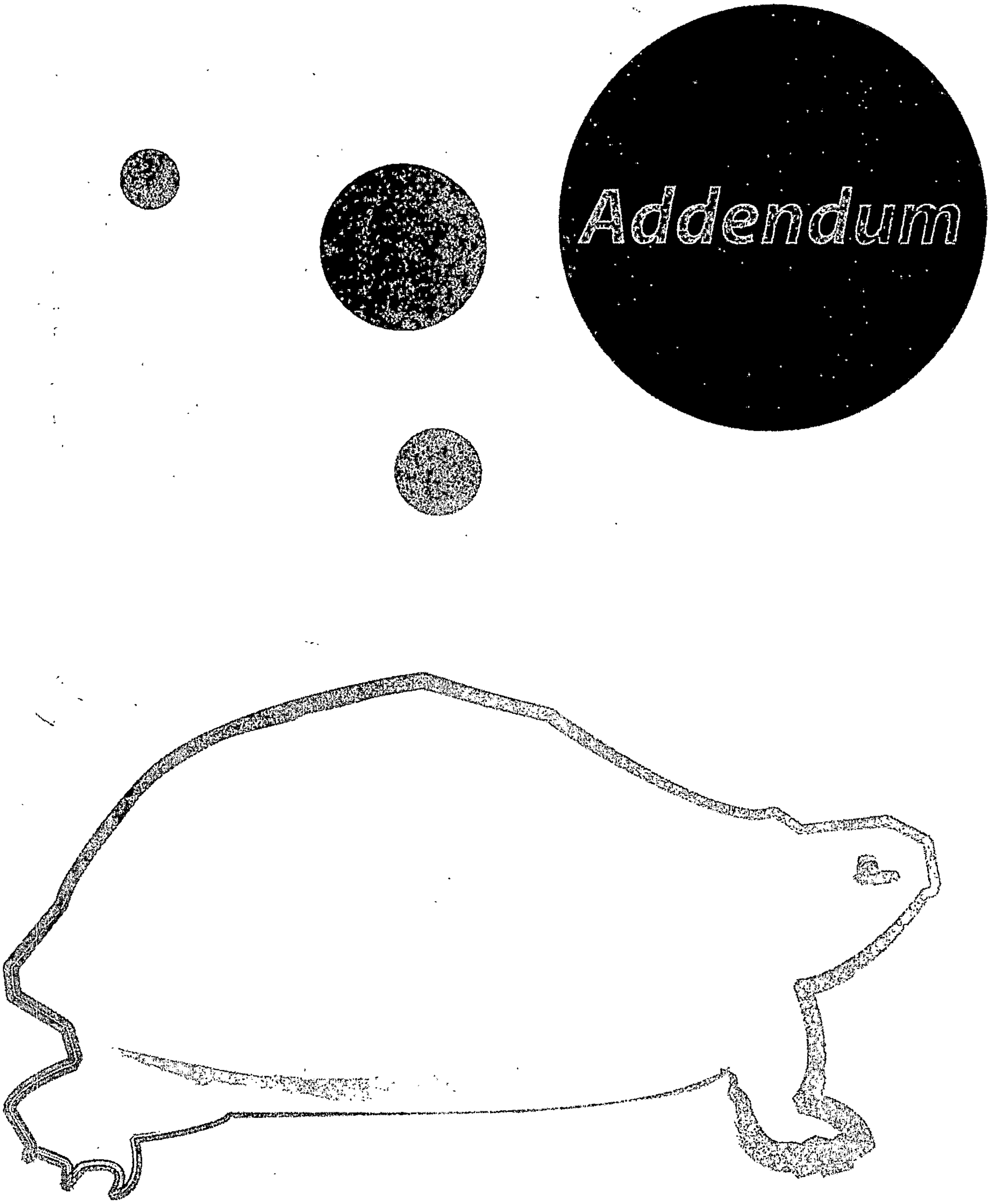
wetland
  economic value, 92

women
  aquaculture
    involvement Taiwan, 121
  development marine medicinal plant, 123
  fish trade
    Cambodia Thailand, 122
  fisheries
    involvement, 115
    involvement Bangladesh, 136
    involvement Taiwan, 121
    management, 139
    policies Philippines, 133
    traditional belief custom, 135
  fishing
    Kiribati, 113
  fishing community Indonesia, 131
  management
    mussel oyster Philippines, 112
  processing
    seafood Sri Lanka, 124
    shrimp Bangladesh, 125
    traditional Proshika Bangladesh, 126

WorldFish Center
  technology dissemination Bangladesh, 61

yield
  impact stocking indigenous, 43

Addendum



A REPORT OF HERMAPHRODITIC GONAD IN *Nemacheilus angorae*

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This study is to document a hermaphroditic gonad in *N. angorae* which has not been reported before in the literature.

Twenthy specimen of *N. angorae* in different stages of maturation were used in this investigation.Sections about 7-8 µ thick were made of the male gonads and stained with H & E.

Approximately fifthy percent of these sections showed hermaphroditic conditions.The ova were observed in previtellogenic stage in these male gonads. This cells were stanined deep blue with hematoxilin.The nucleoli of oocyts seen beneath the nuclear membrane and in a large number representing a high activity of these cells .Oocyts were interspersed among seminiferous lobules .The number of ova differed according to different sections (e.g. 3-100).The testes tissues bearing Oocytes were quite matured and the spermatozoa were seen in different stages of maturation. The gonads which showed testicular and ovary structure simultaneously were seen in individuals about 58 -68.5 mm length.

A MEAN WEIGHT AND MEAN LENGTH STUDY ON SPINY LOBSTER *Panulirus homarus*

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This study was carried out to assess the impact of fishing on the spiny lobster, *Panulirus homarus*. About 25,000 specimens were collected. The mean total weight and carapace length for these specimens were measured in 1991, 1994, 1996, 1998, 2001 and 2003. Mean carapace length and total weight are given in Tables 1 and 2. There were significant decreases in length and weight from 1991 to 1994, followed by a subsequent increase again in 1996. There were no further increases in 1998. These patterns can be explained by the fact that the first exploitation of this species at a commercial scale occurred in 1991, so naturally the highest means belong to this year. The decrease of mean weight and mean length by 1994 reflects fishing during the ensuing period. There were no fishing regulations during these years. Regulations were introduced in 1995, and the fishing season was limited to 2 months per year. The increase in mean weight and mean length from 1994 to 1996, and the relative stability of these values until 2001, was due to these regulations and effective management of the fishery. However, high prices for lobster in Pakistan during recent years have led to illegal fishing during the closed season, and smuggling to Pakistan. The decrease in mean length and weight in 2003 reflects this serious situation.

Table 1 Carapace mean length (mm) during the years

Sex	1991	1994	1996	1998	2001	2003
Male	81.22	72.39	76.18	76.36	80.13	70.45
Female	76.61	73.09	74.84	74.34	75.66	72.1

Table 2 Total mean weight (g) during the years

Sex	1991	1994	1996	1998	2001	2003
Male	505.50	393.20	436.68	449.46	486.64	381.78
Female	473.94	420.59	438.17	445.55	467.59	411.69

PARASAMAZA ABSTRACT THEME: VOICING FOR PUBLIC ACTION

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The existing norms and values of our society have implicitly and explicitly placed women and girls at a vulnerable and disadvantaged position. This is further felt and manifested in fishing communities in Zambales where fisher-women's rights continue to be violated as evidenced by the growing number of cases both reported and unreported in the province. The growing poverty in the sector has further exacerbated this disadvantaged position of women.

Pampangisdaang Reporma Adhikain ng Maliliit na Mangingisda ng Zambales (PARASAMAZA, Inc.) is a provincial federation of fisherfolk associations and cooperatives in the province of Zambales. It's women arm, the PARASAMAZA-Women, is a venue for the women members and leaders to come together, strengthen their links, identify issues and concerns, advocate their agenda, and address women-only concerns.

The paper will present the efforts of PARASAMAZA-Women as it advocates for reforms in order to address the various women's concerns by:

1. In the Provincial Level:

Taking a lead in the creation of Zambales Women's Welfare and Development Council which is tasked to formulate policies and recommend measures to address women's concerns for legislation of local Sanggunian, form plans to alleviate women's plight, take the lead in organizing women and encourage active participation and involvement in government affairs, nation building and environmental protection

2. In the Local Level:

Providing capability-building, gender awareness, facilitating access to social services and livelihood support to women members of the federation.

3. In the National Level:

Pushing for genuine reforms and rural women's rights and agenda.

The presenter is currently the chairperson of PARASAMAZA and is actively involved in various women and gender mainstreaming efforts. A woman-leader, she is also in the field of organizing and advocacy especially for issues affecting women in fisheries.

COMPARISON BETWEEN BIOLOGY OF *Pontogammarus maeoticus* IN TWO POLLUTED AND NON-POLLUTED LITTORAL REGIONS OF CASPIAN SEA

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Two polluted and non-polluted littoral regions of Caspian Sea were determined to study organic pollution on biology of *Pontogammarus maeoticus*. Animals were sampled from estuary region of Lavidge River as a polluted area and also shores of Faculty of Natural Resources and Marines Sciences as clean area. Sampling was carried out during two summer months (July and August) with two weeks intervals. In both regions, population of coupled animals, length, animal's dry and wet weights were determined in both areas. Results revealed no differences in animal lengths, their dry weights and population of coupled animals in both regions. However, animals in polluted region had lower wet weight than clean area.

FISH BIODIVERSITY IN SOME HIGHLANDS (MOUNTAINS AND HILL RANGES) OF THE INDIAN SUBREGION

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Present investigations resulted in 361 species of fish of 123 genera, 35 families and 11orders from the highlands of Himalaya (India + Nepal), Central India and the Western Ghats. The Himalayan region harboured largest number of species (258), genera (107), families (35) and orders (11) compared with 160 species, 67 genera, 18 families and 10 orders in the Western Ghats (WG) and 96 species represented by 55 genera, 20 families and 8 orders from Central Highlands (CH). The cyprinids were most dominant represented by 150 species. Forty three species were common to these highlands. In addition, 39 species were common to Himalaya - CH, 12 to CH - WG and 23 species to Himalaya - WG. The number of species restricted in the Himalayan region was much higher (142 species) than the WG (81 species) and the CH (13 species) attributed to Assam-Gateway through which Indo-Chinese and Malayan elements invaded the highlands. Discontinuous distribution was observed for 15 species, which existed in the Himalaya and the WG but not in the CH. The discontinuity of the Peninsular and eastern fauna is essentially an impoverishment of the faunal complex resulting from climatic change to biological introductions.

New Dimensions and Challenges in Asian Fisheries in the 21 Century